Vol. XXII., No. 4. 1896. Whole No. 80.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XXII.

EDITED BY H. G. DRESEL.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

Vol. XXII. No. — 1896. Whole No. 80.

PROCEEDINGS

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ANNAPOLIS, MD.

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BALTIMORE, MD.

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OF THE

UNITED STATES NAVAL INSTITUTE.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE RIGHT OF SEARCH AND ITS LIMITATION IN TIME OF PEACE.*

By Professor Theodore S. Woolsey.

Visitation and Search in Time of Peace.

One of the striking features of the present century is the growth in the freedom of international trade. This has been the result of the closer relations between states in time of peace, and of the greater influence of those who choose a neutral attitude in time of war. A single example of the former is the downfall of the colonial system, under which trade between a state and its colonies was exclusively reserved to the channels of that nationality, all foreign ships being shut out.

The extent of the neutral interest is best seen in the Declaration of Paris in 1856, which gave him the right to carry enemy's goods safely, and also the privilege of lading his own goods on enemy's ships without liability of capture. Now rights and

* Lecture delivered at the U. S. Naval War College, August 4, 1896.

duties are correlative. It is proper when neutral rights are enlarged that the neutral duties which remain shall be all the more strictly enforced. Such enforcement is possible only through the examination of vessels. In this connection it is well to quote that famous dictum of Lord Stowell, the greatest of the English Admiralty Judges, in the case of the Maria (Robinson, Adm. Rep. V, 367). He asserts "the right of visiting and searching merchant ships upon the high seas, whatever be the ships, whatever be the cargoes, whatever be the destinations, by the lawfully commissioned cruisers of a belligerent nation, . . . because till they are visited and searched it does not appear what the ships or the cargoes or the destinations are; and it is for the purpose of ascertaining these points that the necessity of this right of visitation and search exists." Necessary it certainly is, but restricted it is likewise, and its limitations as well as its necessity are stated by Lord Stowell. It is applicable to merchantmen only, on the high seas only, and solely in time of war.

Would that the British navy had always observed those restrictions! Even now one cannot think without a flush of rage, of that melancholy day when the Leopard followed our Chesapeake out to sea from Hampton Roads and claimed and exercised the right to impress three seamen from the crew of the helpless frigate. But this at least resulted from the outrage, that once and for all the English Government admitted that its right of search did not apply to a United States man-of-war.

The limitation of the right of search to the high seas is not quite exact, for it may be exercised of course within a state's own waters or the waters of its enemies and its allies, but neutral waters not a part of the high seas are exempt from it.

The third limitation, to war-time, is recognized in the amplest way by all authorities, our own included. "The Government of the United States," wrote Mr. Adams, Secretary of State, to Messrs. Gallatin and Rush in 1818, "has never asserted, but has invariably disclaimed the pretension of a right to authorize the search by the officers of the United States, in time of peace, of foreign vessels upon the high seas without their jurisdiction."

In the light of this statement, the choice of "Visitation and search in time of peace" as our topic may seem rather Hibernian. Like that famous chapter on snakes, my discussion should consist of but a single negative sentence.

And yet though the rule is true, a variety of causes may alter or suspend it. Treaties may do this; the necessity of self-defense may do this; the exigencies of a country's policy may attempt this.

Then, too, there may be search in time of peace on suspicion of piracy, for a portion of your duties, gentlemen, lies in the policing of the seas. Now the modern pirate does not, as a rule, hoist that black flag and Jolly Roger in the presence of a ship of war, which, as every one knows, are essential to his peace of mind. On the other hand, if you search on suspicion and find your pirate to be a harmless trader, you may be personally liable in damages. It will appear, therefore, I think, that there are, if not genuine exceptions to the rule that the right of search is a belligerent right in war only, at least such real or attempted modifications of it as to be worthy of our study. We may not succeed in laying down a hard and fast law, but I trust that we may call attention to some historical aspects and some modern phases of the question which will not be without interest.

During the early years of this century, and in truth for some time before them, there was one matter which embittered our relations with England more than all others—the impressment of seamen on board American ships. The exasperation which sprang from this practice influenced our national policy in another question for nearly fifty years.

The legal basis for the claim to impress seamen out of foreign ships was the doctrine of the indelible allegiance of every British subject to the Crown. Neither emigration, naturalization, foreign marriage, or any other circumstance could wipe it out. This led to some curious inconsistencies. Thus an English woman marrying a foreigner remained an English subject; a foreign woman marrying an Englishman became an English subject.

An Englishman naturalized abroad, acquired thereby obligation of military service, while still retaining the same obligation to the country of his origin. So that in case of war between them, to one of the two he must of necessity prove a traitor. This theory, which our own courts inclined to follow, was not surrendered until the English Naturalization Act was passed in 1870.

The *practical need* for impressment lay of course in the demand for seamen, the unpopularity of the English naval service, and the tendency to escape from it by shipping on foreign, largely American, vessels. This was particularly true in time of war, and most of all during the tremendous struggle against Napoleon in which Britain was engaged. And while enforcing her genuine belligerent rights against the neutral, it was easy and tempting to class search for impressment purposes amongst them. She pretended to limit it to time of war. In point of fact, however, the right was exercised against foreign vessels in time of peace as well. Diplomatic protest was made in 1792 against the practice; it had become a crying evil in 1794, when Jay's treaty was signed; it is believed to have been enforced likewise during the Peace of Amiens. And as it never was a *belligerent* right, it is fairly a part of our subject.

Now the impressment of seamen claimed as British subjects from American vessels involved the stopping and searching of some hundreds of such vessels under circumstances of the greatest exasperation and sometimes of loss. The Yankee skipper, perhaps already short-handed, saw his crew mustered by some arrogant young officer of a country which he liked none too well, and half a dozen of his smartest men dragged into the English service, their British nationality being assumed on the slightest evidence, and thus frequently mistaken. These suffering seamen, the captains and the shipowners, united for years in unavailing complaints. In 1803 an agreement to abolish the claim was nearly reached. It failed because England insisted upon retaining it in the narrow seas. And some years later came the proposal that the practice should be allowed by the United States, but subject to damages for any mistake as to nationality. This, however, would have authorized the impressment of foreign seamen from our ships and did not meet our real objections.

In truth, the right was never formally relinquished; it simply died out.

What was the flaw in the English theory and practice? It was not in the claim to unchangeable allegiance: that is a matter of state policy.

It was not in the claim to impress men for service on English men-of-war. That was a lawful measure which, though harsh

in its working, might well have seemed in that day essential to the safety of the state. It was a naval draft law, irregularly and violently applied. No! The real difficulty in the English theory was, that it was a claim to apply a municipal law outside of English jurisdiction; that it was a violation of the sovereignty of a friendly state. The search of a foreign ship, on the high seas, to enforce, not a belligerent right but a municipal ordinance, had absolutely no foundation except the right of the strongest. And so in time it lapsed, but not without leaving a trail of animosity behind.

For the enforcement of their revenue laws, several states have claimed and exercised the right of search upon the high seas in time of peace, and this practice, if legitimate, would be a genuine exception to our rule. Thus statutes forbidding transhipment of cargoes within four leagues of the coast have been in force from the last century both in England, under the name of the Hovering Acts, and in the United States of America, and according to Wheaton, "have been declared by judicial authority in each country to be consistent with the law and usage of nations." Portugal and Spain have asserted similar rights, but only to find that England was less ready to concede than to make such claims. The fact is that such statutes are good only when acquiesced in by foreign states, in accordance with the comity of nations. For they are only municipal, not international laws. They assert for a special purpose jurisdiction beyond the three miles of coast sea which is commonly conceded to be the limit of a state's territorial waters. Even if the extent of coast sea jurisdiction has been enlarged by the larger range of modern cannon, which is not the theory of our own Government, no such width as four leagues has been claimed for it. These Hovering Acts are really then, so far as legal authority goes, no better founded than the impressment claim. If the United States, for enforcement of revenue or health laws, boards a foreign ship four leagues out from New York and seizes her on suspicion, the said seizure may be complained of by her own Government, and we can point to nothing but many years of acquiescence in justification. In this opinion, I believe, modern publicists are pretty well agreed.

Twiss states his opinion thus: "A state exercises in matters of trade for the protection of her maritime revenue, and in mat-

ters of health for the protection of the lives of her people, a *permissive jurisdiction*, the extent of which does not appear to be limited within any marked boundaries, further than that it cannot be exercised within the jurisdictional waters of any other state, and that it can only be exercised over her own vessels and over such foreign vessels as are bound to her ports." He adds that if these regulations "should be such as to vex or harass unnecessarily foreign commerce, foreign nations will resist their exercise." *

Lawrence, the latest English writer on these subjects, quotes Twiss approvingly, and also Dana, the best of the editors of Wheaton, to the effect that "the right to make seizures beyond the three-mile limit (and this involves a preliminary search) has no existence in modern international law." Lawrence adds: "It is very doubtful whether the claim would be sustainable against a remonstrance from another power. . . . When it is submitted to, the submission is an act of courtesy." †

Although the law of 1799 still stands upon our statute book, it is doubtful if the attempt to enforce it would now be made, while the British Hovering Act was repealed by the Customs Consolidation Act of 1876, Sec. 134. We have probably seen the last of this curious extension of revenue jurisdiction.

Akin to this right of search for revenue purposes, is the claim to capture outside of the territorial waters of a state, for a breach of revenue laws committed inside, after hot pursuit. Here the theory is that a distinct offense against the state has been committed, and that the application of the penalty should not be limited because in escaping the wrong-doer has crossed the three-mile limit and gained the high seas. Even in this case no right of search exists. For in the case of the Marianna Flora (11 Wheaton, 42) the Supreme Court declared that such chase "has never been supposed to draw after it any right of visitation or search. The party in such case seizes at his peril. If he establishes the forfeiture he is justified."

I have sometimes wondered on what ground that sensational pursuit of the Itata by the Charleston was ordered. As a speed

* Sir Travers Twiss. The Law of Nations. In Time of Peace. 1st edition, page 263.

† The Principles of International Law, p. 176.

trial it was interesting, and I believe satisfactory. But the only fault committed by the Chilian ship was a petty breach of the port regulations of San Diego, as the Government might have learned, while the pursuit was not hot, but began at San Francisco, four hundred miles away. The trial of the Itata, after her voluntary surrender by the Chilian Junta, showed that she was not fitted as a man-of-war, nor was she an armed expedition. The Chilian revolutionists had the same right to buy arms in the United States that the Cubans have now. Suppose a Cuban brig to enter at New Haven, act rather mysteriously, ship a cargo of Winchester rifles and cartridges, and make off without clearance papers. Then let the New York or the Columbia, lying in Boston harbor, be ordered in pursuit. The brig eludes her pursuer, reaches her port safely, but is surrendered with her cargo by the insurgents, who desire to stand well with our Government. This is a parallel case to that of the Itata. I think it has only to be stated to show the wrong-headedness of the Itata order.

The Bering Sea controversy is another instance of a claim to search and capture on the high seas, in enforcement of municipal, not international laws, which rightly, and fortunately, as it seems to me, has not been upheld. For it would have been unfortunate indeed if the United States, which has so consistently and manfully in the past stood for the freedom of the seas, should suddenly from interested motives try successfully to establish the opposite.

We approach now another topic, in connection with which the right of search in time of peace rests upon a surer basis—that of treaty agreement.

Early in the present century a remarkable agitation in England, led by men like Sir Fowell Buxton, Wilberforce, and Clarkson, forced upon the Government the policy of slave trade prevention. To accomplish this, the right of search was essential. This right, with seizure in case of guilt, was secured by a series of treaties between Great Britain and Spain, Portugal, the Netherlands, Sweden, and finally France, each of these states making the slave trade a criminal act by law. Now, since several of these treaty powers had no efficient cruising navy, the responsibility of making these laws effective was assumed by the British Government, though of course the treaties were

It was just before this treaty that the British Government propounded a new theory—the right of visit as disconnected with the right of search. Now really this claim to visit a ship for the purpose of inspecting her nationality—(to see if she might not belong to a state with which the treaty right of search subsisted, using a false flag for concealment)—though expressly denying it to be so, was simply the belligerent right of search in disguise. It was stated by Lord Aberdeen thus: "The sole purpose of the British cruisers is to ascertain whether the vessels they meet with are American or not. The right asserted has in truth no resemblance to the right of search, either in principle or in practice. It is simply a right to satisfy the party who has a legitimate interest in knowing the truth, that the vessel actually is what her colors announce. This right we concede as freely as we exercise. The British cruisers are not instructed to detain American vessels under any circumstances whatever, on the contrary they are ordered to abstain from all interference with them, be they slavers or otherwise. But when reasonable suspicion exists that the American flag has been abused for the purpose of covering the vessel of another nation, it would scarcely appear credible . . . that the Government of the United States, which has stigmatized and abolished the trade itself, should object to the adoption of such means as are indispensably necessary for ascertaining the truth." The same claim was asserted by others even more forcibly, but with the promise of damages in case of mistake and loss from its exercise.

Mr. Webster, in combating Lord Aberdeen's view, denied "any broad and generic difference between what has been usually called visit and what has usually been called search," asserting "that the right to visit, to be effectual, must come in the end to include search, and thus to exercise in peace an authority which the law of nations only allows in time of war. If such well-known distinction exists, where are the proofs of it? What writers of authority on public law, what adjudications in courts of admiralty, what public treaties recognize it?" And he goes on to assert that by publicists of all nations, by judges in their courts, and by statesmen in their diplomacy, the words visit and search have been used hitherto in the same sense.

To a practical mind it seems to me clear, that even if per-

British act of Parliament, nor any commission founded on it, could affect any right or interest of foreigners, unless it was founded upon principles and imposed regulations consistent with the law of nations. The first matter of inquiry was whether there was any right to visit and search. If there was no such right, and if it was only in the course of an illegal exercise of this right that it was ascertained that Le Louis was a French ship trading in slaves, then this fact having been made known to the captor by his own unwarranted acts, he could not avail himself of discoveries so produced. At present no nation could exercise a right of visitation and search upon the common and unappropriated parts of the sea, save only on the belligerent claim. The right of visit in this case could only be legalized upon the ground that the captured vessel was to be regarded legally as a pirate. But slave trade was not piracy in legal consideration, not was it a crime by the universal law of nations. A nation had a right to enforce its own navigation laws so far as it did not interfere with the rights of others, but it had no right in consequence to visit and search all *apparent* vessels of other countries on the high seas in order to institute an inquiry whether they were not its own vessels, violating its own laws." This was ten years and more before the French treaty granting search reciprocally. A similar mistaken reasoning, to be followed by a similar return of reason, took place in our own country, the Supreme Court in the Antelope (10 Wheat. 66) declaring that it was not the practice of the courts of any country to execute the penal laws of another.

This attempt to secure the right of search by judicial interpretation thus broke down, but the problem of slave trade prevention remained, and two attempts were made to solve it by treaty agreement. It was not until 1842, however, that this policy resulted in anything. It took the form of an agreement with Great Britain to maintain separate squadrons of eighty guns each on the African coast, to act in concert so far as possible. This still excluded a mutual right of search, and this omission was the cause of ineffectiveness. For unless ships of both countries cruised together, a vessel with American papers could escape British search and capture, in spite of the strongest suspicion, while damages were due for the detention of a lawful trader.

Under this treaty of 1862, twice modified, the two countries are still acting. The right of search is granted only to vessels of war expressly authorized, thus denying it to the ordinary cruiser not on prevention of the slave trade service. It applies to merchantmen only, and in certain waters, namely, within two hundred miles of the coast of Africa south of the thirty-second degree of north latitude, and within thirty leagues of Cuba, Porto Rico, San Domingo, and Madagascar. Its method of application is carefully laid down to insure courteous treatment and prevent abuse, and damages for loss by illegal detention shall be borne by the respective governments. Mixed courts were set up to try slave-trading cases, but in 1870 these were abolished. The evidences of character, such as extra water casks or mess tubs, shackles, grated hatches, an unusual quantity of rice or other food with boiler for cooking it, and so on, were specified. And finally the treaty was made terminable after 1872, at a year's notice. Thus search as a right, asserted for seventy years by Great Britain for one purpose or another, gradually whittled down into visitation, then yielded altogether, became search under treaty. It is one more proof of our dictum that the right of search in time of peace does not exist.

Search on Suspicion of Piracy.

At one period of the slave-trade agitation (1824) the United States proposed to unite with a number of other powers in making that inhuman traffic piracy by statute and treaty. By this was meant only that slave-trading, as between the signatories, should be punished like piracy. Statutory piracy like this is under the ban of that state only which legislates against it. But the genuine article, piracy *jure gentium,* is quite another thing. It has two important characteristics. The first is that being committed upon the high seas, or by descent upon unoccupied land from the high seas, it is a crime which is not within the jurisdiction of any one state. The second is that it is not aimed at any one state, like privateering, but its *animus furandi* is general, it is war upon civilized society. It follows that all states have laid upon them the duty of suppressing piracy, and the courts of any nation have jurisdiction over it. In other words, it is part of the duty of every ship of war to search for and arrest pirates, while any admiralty court is competent to pass upon their character. This

is sufficiently familiar ground. But to us here there comes the practical question how this duty shall be exercised. It is inaccurate to call such right of search a belligerent right, because piracy is war upon human society. There is no more war than there is between a gang of ruffians in Oklahoma and the United States. It is simply a detail of naval police duty, in which you suspect a ship from her history or her appearance, and search or perhaps seize her in order to make her character clear. But suppose you make a mistake. By your action freight goes unearned, wages are wasted, a voyage is lost. Who stands the damage? And, moreover, what does search mean, when is it justifiable, how can you lawfully find out the character of a ship which appears to you in doubt?

Here we come upon the American doctrine of the right of approach. The English theory of visitation meant stopping a merchantman, inspecting her papers, ascertaining her real nationality and character by means which fell little short of search. The American theory of approach involved only closing in upon a ship for a nearer look, she meanwhile pursuing her voyage. It seems to have been first definitely laid down by the court in the noted case of the Marianna Flora (11 Wheaton, 40). It was in November, 1821, that the United States armed schooner Alligator, cruising against pirates and slavers, fell in with a strange sail. Their courses crossed, and the ships were separating, when the stranger shortened sail and slightly lowered a vane or flag—not a national flag—on her mast. These acts Lieutenant Stockton interpreted to be signals of distress, and approached accordingly. As he came up he was fired upon, and an encounter took place which ended in the surrender of the Portuguese trader Marianna Flora.

Stockton made no careful examination, but sent his prize in on the charge of piratical attack. Her story was that she mistook the Alligator for a pirate and acted in self-defense. The lower court acquitted the ship and awarded damages against Stockton. Appeal was taken to the Supreme Court on this question of damages, a matter of close upon twenty thousand dollars. In behalf of the claim it was urged that Lieutenant Stockton's approach, as well as the subsequent seizure, was unjustifiable; that the mere fact of approach authorized the attack. This claim, said Mr. Justice Story in giving the opinion, the court feels itself bound

to deny. It was argued again that the Alligator was bound to lie out of cannon-shot in making visitation and search. The answer was that this was no visitation and search, but an approach induced by the supposed signals of distress and other reasons.

"As we understand the general and settled rules of public law," said the court, "in respect of ships sailing under the authority of their government to arrest 'pirates and other offenders,' there is no reason why they may not approach any vessels descried at sea for the purpose of ascertaining their real characters. Such a right of approach seems indispensable for the fair and discreet exercise of their authority; and the use of it cannot be justly deemed indicative of any design to insult or injure those they approach or to impede them in their lawful commerce. On the other hand it is clear that no ship is, under such circumstances, bound to lie by, or wait the approach of any other ship."

And accordingly the decision of the lower court was reversed and damages refused. The Alligator had acted honestly though mistakenly, and there was enough ground for suspicion to warrant the capture.

In 1843 Mr. Webster quoted this opinion as expressing his view of the means which a vessel of war may use in peace to ascertain the character of any other ship on the high seas.

President Tyler, in a message to Congress the same year, incidentally lays down the same rule. "To seize and detain a ship upon suspicion of piracy with probable cause and in good faith, affords no just ground either for complaint on the part of the nation whose flag she bears, or claim of indemnity on the part of the owner. The universal law sanctions and the common good requires the existence of such a rule. The right under such circumstances, not only to visit and detain, but to search a ship, is a perfect right and involves neither responsibility nor indemnity." Do not overlook his phrase "upon suspicion of piracy with probable cause," for it conditions the whole statement.

With these opinions, judicial and official, the text-writers seem to agree.

Chancellor Kent concedes the right of approach (as described by the United States Supreme Court in the Marianna Flora) for the sole purpose of finding out the real character of a vessel under suspicion. (Kent's Com. I, 153.)

Ortolan, the French publicist, himself an officer in the navy,

distinguishes inquiry into the nationality of a ship from a search of her. Upon legitimate suspicion of piracy, however, you may search, but subject to the payment of damages by your government. (Ortolan, Dipl. de la Mer, III, 7, p. 258, 4th ed.)

The English writer Lawrence, publishing in 1895, when speaking of prize court procedure, says: "If the grounds on which the capture was effected turn out to be good, condemnation will ensue and the captors will receive the proceeds of the sale of the captured property in the form of prize money. If the evidence against the vessel is not conclusive in spite of circumstances of just and reasonable suspicion, she will be released, but her owners will have to bear the expense of detention and delay. But if the capture was effected on foolish and frivolous grounds, the officer responsible for it will be condemned in costs and damages. And the same rule holds good in the more difficult matter of the treatment of vessels suspected of piracy by the cruisers of non-belligerent powers. Being at peace, they have no right to search unless the ship they have in view is really a pirate, in which case they are free to go further and capture. But they cannot tell whether the right to seize the vessel exists until they have visited and overhauled her. They must, therefore, be guided by surrounding circumstances. Should the information they have received and the behavior of the vessel when approached give rise to a reasonable suspicion that she is a pirate, their commanders are not liable for damages for seizing her, even if it should turn out that her errand was perfectly lawful. But if they have made an inexcusable mistake they must suffer for it. On the other hand, should the vessel be really a pirate, their action is lawful from the beginning, and they have performed a meritorious service." (Lawrence, Int. Law, p. 395.)

Here, then, we have the rule clearly stated. Yet the rule itself is not clear. It is part of a navy's duty to suppress piracy. A ship of war may lawfully take a close view of any vessel. Upon suspicion of piracy it may search and even seize that vessel. If the suspicion turns out to be well founded, the search and arrest were meritorious acts. But if the search shows no fair ground for suspicion, then damages are due. To determine whether a suspicion *was* justified or not is easy for a court with means of securing evidence at its command. To determine from an outside view whether search is *likely* to be justified, is not so easy for

the naval officer who between duty and damage is between the devil and the deep sea.

We must hope that the new photography will be equal to this dilemma, and that a search-light may be discovered of such power and quality as to give us a shadowgraph of the ship's interior, the captain's intentions and the hearts of the crew.

One more inquiry, gentlemen, and my topic will be threadbare. May there not be a right of search on the high seas in time of peace, founded upon and justified by the right of national defense? Self-defense has been called the first law of nations as of individuals. It has sometimes been held to justify very gross violations of the jurisdiction of one state by another, as in the case of the Caroline. Have we not here a genuine exception to our general rule? A case which brought up this question among others is that of the Virginius. It was in 1873 during the first Cuban insurrection, to which no belligerent rights were accorded by this country. The Virginius had an American register and flew our flag. For nearly three years she had been employed by Cuban sympathizers in delivering men and arms from various points. Late in October, 1873, at Kingston, Jamaica, she took on a body of drilled Cubans, nearly one hundred in number, who had come down by steamer from New York. To these were added certain Cuban leaders and eighty men who had been picked up separately. She sailed for San Domingo, was warned away, and then went to Port-au-Prince, in Hayti, where she loaded a quantity of arms and ammunition. She made a further stop at Corinto, shipping additional military supplies, with shoes and clothing. Thus assembling an organized body of men and material of war for their use, she was clearly engaged in transporting a military expedition and not mere contraband articles. From Corinto crossing to Cuba she cruised eastward along the coast seeking a landing. Off Point Guantònomo, six miles from shore, the Spanish cruiser Tornado came in sight. All the Spanisl men-of-war had been warned to look out for and capture the Virginius; that is, her character and business were notoriou . She ran out to sea towards Jamaica, but finding herself ove.-hauled, threw the military portion of her cargo overboard and then surrendered, relying upon her American flag and register. At Santiago de Cuba, where she was taken, her passengers and crew were summarily tried by court-martial. Four were shot on

the fourth of November, thirty-seven on the seventh, sixteen on the eighth; of those executed, nine were Americans and sixteen British subjects. There were over one hundred left, but further executions were stopped by the remonstrances of the British officials.

The effect of the news of this affair in the United States was tremendous. A cry of rage and warlike desire went up, the like of which was not heard again until 1891, apropos of the attack by a Valparaiso mob upon the seamen of the Baltimore.

Although aware that a doubt existed as to the real ownership and nationality of the Virginius, Secretary Fish completely disregarded this and through General Sickles, our minister at Madrid, demanded the surrender of the survivors, the restoration of the ship, and a salute to the United States flag, under threat of breaking off diplomatic relations in twelve days. To this the Spanish Government yielded, with the single proviso that if the ship proved to have gotten her American register fraudulently, as turned out to be the case, the salute should be dispensed with.

Now there are several interesting questions involved in this Virginius case, and perhaps it is simpler to reach that particular inquiry which relates to the right of search by process of exclusion.

Let us set apart then entirely the summary execution of two-fifths of the crew as an act barbarous, unjustifiable and directly in violation of treaty. They were taken with no arms in their hands; they were shot, not in self-defense, but in revenge; they were in no sense pirates *jure gentium*; they were tried by drum-head court-martial, whereas Art. VIII of the treaty with Spain of 1795 distinctly provides that "in all cases of seizure, detention or arrest for . . . . offenses committed by any citizen or subject of the one party within the jurisdiction of the other, the same shall be made and prosecuted by order and authority of law only, and according to the regular course of proceeding usual in such cases," with full right to employ counsel. This same treaty provision has been successfully invoked within a few months to protect the few Americans captured on the filibustering ship Competitor from similar execution as the sequence of a similar trial.

When Americans are captured fighting against Spain, with arms in their hands, they must be held to have entirely identified

themselves with the insurgent cause and to have lost the right to protection which their nationality would give them. Under other circumstances a fair trial, under the treaty, cannot be refused them. But however indignant we may be at this instance of Spanish inhumanity, we must not allow our calm estimate of Spanish rights to be prejudiced thereby.

The next inquiry turns on the nationality of the ship. The investigation of the Attorney-General brought out these facts: The Virginius had been granted an American register on the oath of an American citizen that he was her owner. The law requires in addition a bond signed by the owner and captain with sureties, but no sureties were furnished. It appeared also that the real owners were certain Cuban sympathizers who furnished the purchase money and had controlled the ship's movements for nearly three years.

On these two grounds of defective bond and foreign ownership, the ship was declared to have no American nationality. If not an American ship, what ship was she? Clearly she belonged to that state to which her real owners belonged, that is, to Spain. Mr. R. H. Dana, the learned editor of Wheaton, is explicit on this point, writing in a Boston paper of January 6th, 1874, that actual ownership by a person belonging to a state places a ship on the high seas under the jurisdiction of that state, and applying this law to the Virginius. Over a Spanish ship on the high seas the Spanish Government had complete jurisdiction to search, to seize, to condemn her according to its own laws.

And conversely over a Spanish Virginius our own Government had no jurisdiction. For the surrender of the ship, for the release of the foreign portion of the crew, for the apology due our flag, it had no lawful claim. But of all this the administration seems to have been singularly heedless. For President Grant in his message to Congress of January 5th, 1874, declares that the Virginius would "appear to have had, as against all powers except the United States, the right to fly its flag." And again, "If her papers were irregular or fraudulent, the offense was one against the laws of the United States, justiciable only in their tribunals." And in the promise of surrender by Spain he finds recognition of the soundness of his position. He knows of the doubtful registry and ownership of the Virginius, yet completely ignores the consequences which would flow from proof of Spanish ownership.

His claim amounts to saying that a foreign ship which has fraudulently secured an American registry and fraudulently flies an American flag is thereby divested of foreign nationality and becomes an American vessel subject to the punishment of its owners for a violation of our laws.

The third point to which I ask your attention is akin to this, but bears directly upon our subject. After showing that the American register of the Virginius was fraudulent and that she had no right to fly the American flag, the Attorney-General added: "I am also of opinion that she was as much exempt from interference on the high seas by any other power on that ground as though she had been lawfully registered." This is equivalent to saying that, so far as Spain was concerned, the fact that the Virginius carried an American flag—whether fraudulently or not—was conclusive; that Spain lost its jurisdiction over its own ships if they could fraudulently show another flag and register. It is safe to say that we should never allow another state to assert such a monstrous doctrine against us. It was warmly attacked by some of the leading jurists in the country at the time, in spite of the popular outcry. Thus, Mr. Dana said: "The register of a foreign nation is not, and by the law of nations is not recognized as being a national voucher and guarantee of national character to all the world, and nations having cause to arrest a vessel would go behind such a document to ascertain the jurisdictional fact which gives character to the document, and not the document to the fact." Pitt Cobbett (Leading Cases Int. Law, p. 93) comments thus upon the question of the finality of the flag: "It is necessary to remember that had the Cuban insurgents been recognized as belligerents the public vessels of each combatant would have been entitled to exercise the right of visit and search in regard to neutral vessels on the high seas. In default of a recognized state of belligerency it can scarcely be maintained that even on the high seas the flag is final, and absolutely precludes a state engaged in suppressing an insurrection from molesting a vessel suspected of aiding rebels." And he goes on to say that upon suspicion that a ship is waging war against a state, or is really owned by its subjects, search is justifiable, but limited by the necessity of compensation in case of mistake.

And now to go one step farther.

It seems to me not unreasonable to assert that, even if the Virginius had been an American ship, entitled to her flag and with a register of unquestioned validity, Spain had nevertheless the right to search her and to seize her on the high seas, on the ground of self-defense. She and her like were feeding the insurrection with supplies and with men. They were dangerous, the Virginius notoriously so. Is not the right of self-protection under such circumstances paramount to every other right? It is noticeable that the English Government, though protesting against the hasty execution of her subjects on the Virginius, made no complaint of the seizure of the ship. It demanded their release, yet said at the same time, "Much may be excused in acts done under the expectation of instant damage in self-defense by a nation as well as by an individual. But after the capture of the Virginius and the detention of the crew was effected, no pretense of imminent necessity of self-defense could be alleged."*

And Hall adds (2nd ed., p. 252): "It is clear from this language that the mere capture of the vessel was an act which the British Government did not look upon as being improper, supposing an imminent necessity of self-defense to exist." Yet there were more British subjects executed than American, and Great Britain is thought to take uncommonly good care of her citizens' lives.

Similarly Mr. Geo. Ticknor Curtis, in an able discussion of the case in 1874, says: "It will be seen, therefore, that we rest the seizure of this vessel on the great right of self-defense, which, springing from the law of nature, is as thoroughly incorporated into the law of nations as any right can be. No state of belligerency is needful to bring the right of self-defense into operation. It exists at all times, in peace as well as in war. The only questions that can arise about it relate to the modes and places of its exercise." †

To quote one more authority, President Woolsey ‡ states the rules of International Law illustrated by the Virginius case as follows:

* Parl. Papers CXXVI, 76, 1874, 85.

† The case of the Virginius, pp. 36, 37, by Geo. T. Curtis, New York and London, 1874.

‡ Woolsey's International Law, 6th edition, page 370.

"1. The right of self-defense authorizes a nation to visit and capture a vessel, as well on the high seas as in its own waters, when there is reasonable ground to believe it to be engaged in a hostile expedition against the territory of such nation.

"2. A nation's right of jurisdiction on the high seas over vessels owned by its subjects, authorizes the detention and capture of a vessel found on the high seas which upon reasonable ground is believed to be owned by its subjects and to be engaged in violating its laws. The flag or register of another nation, if not properly belonging to a vessel, does not render its detention unlawful by the cruiser of a nation to which its owners belong."

From these opinions in opposition to that of the Attorney-General I do not find amongst the publicists who have discussed the affair a single dissenting voice, though one or two do not go quite so far or express themselves quite so clearly.

To me it becomes a clear case if we can imagine the tables turned. Let us suppose that in 1861 Mr. Seward had carried his point and had prevented the recognition of Southern belligerency by any foreign power.

Let us suppose a ship under British colors, but which almost certainly belongs to certain Confederates, to be engaged several times a year in landing men and arms at various points of the Southern coast.

There is no legal blockade because there is no legal war. You have been warned to look out for this ship. You find her attempting a landing. She runs away and you catch her. British ship or not, entitled to her flag or not, is there an officer in our navy, or an official of our government, who would not believe her to be lawfully captured in self-defense and applaud the captor?

But though we admit the right of search in peace on the ground of self-defense, there is still and always will be the practical difficulty of knowing when it is applicable. As in search on suspicion of piracy, there is a duty and there is a danger. We can be sure only in extreme cases. We must weigh every fact and act calmly. Here then is the one real and only exception to the rule that the right of search on the high seas in time of peace does not exist.

In one of Norris' stories, Thirlby Hall, the hero goes to the

village church and pictures for us the drowsy service and the quaint building. There was the old, square pew with its shabby hassocks; the well-remembered musty smell, for which partly damp and partly the remains of his decaying ancestors were responsible; and there was the village choir in the gallery bawling out "I will arise," to the accompaniment of various scriptural rather than musical instruments. And then there was the sermon. "This, like all the rector's discourses, was constructed upon time-honored and unvarying lines. Firstly, what was so-and-so? Was it this? No! Was it that? No! Was it something else altogether improbable? Again no! What then was it? Which led to the agreeable discovery that after all it was very much what the untutored mind would have pronounced it to be at first sight.

"Secondly, how was this doctrine illustrated by examples from holy writ? Examples from holy writ, more or less apposite, followed.

"Finally, brethren, how did this great truth come home to all of us? The unsatisfactory conclusion being that it ought to come home to us in many ways, but that by reason of the hardness of our hearts it didn't. Then there was a great shuffling of hob-nailed boots, a great sigh of relief, and we were dismissed."

I fear, gentlemen, that my lecture is constructed like the old rector's sermon.

The right of search in time of peace, does it exist to enforce impressment laws? No.

Does it exist for revenue purposes? Not as a right, and only by acquiescence.

Does it exist for putting down the slave trade? Only under treaty.

When then is it permissible? Only for suppression of piracy and self-defense, and then with full liability for blunders. And after reaching this very natural conclusion, I seem to hear that same sigh of relief which closed the old clergyman's exhortations.

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THE CHRONOLOGY AND GEOGRAPHICAL DISTRIBUTION OF ICEBERGS IN THE SOUTHERN AND ANTARCTIC OCEANS.

By W. T. Gray, M. S.

Icebergs in the northern oceans have received much attention at the hands of many intelligent writers, but comparatively little has been published in recent years concerning the ice in the southern and Antarctic oceans. It appears from what has been written on the subject that there are years of few or no icebergs, followed by a period of years of a great accession of bergs. Such a period of remarkable frequency of bergs is that of 1891-1895, and with this period, or rather the period from 1888 to 1895, the present essay and its accompanying charts especially deal.

It is not necessary to dwell upon the importance of the ice problem, or the risks and perils of the navigator in the southern oceans, due to the immense floating islands and also to the detached pieces of ice, which are in themselves sufficiently large to do serious damage to the staunchest vessels afloat.

If we could have the testimony of those brave and gallant navigators who have left port in noble ships, and who have neither returned nor left any traces as a basis for speculation as to their fate, we would probably, in many instances, learn of a sudden shock, of the rending, falling masses of ice, the rushing of water, and the quick engulfment of the vessel and crew. The collision with a gigantic iceberg occurs so suddenly and with such terrific force as to appal the bravest.

As in the northern hemisphere the origin of icebergs is in the polar regions, principally in Greenland, so in the southern hemi-

sphere their place of formation is in the Antarctic lands, concerning which we know only a "few discontinuous coast-lines." Reasoning as to their formation, by analogy, from our observations in Arctic regions, we may suppose them to be formed in a similar manner in the south polar regions; that is, from the large glaciers that are formed on sloping lands by the accumulation of falling snows and congealing rain and fog.

These glaciers, "of so imposing and magnificent an aspect, in spite of their apparent immobility, have a descending movement, slow and continuous," toward the sea, and "protruding their margin into the water until the stability of the mass and buoyancy become neutralized and the margin breaks off, or *calves*, as it is termed," and casts those huge masses of fresh-water ice adrift into the "great Antarctic drift current, so called in the Pacific, as well as in the Atlantic and Indian oceans."

"This great body of water moves toward the east between 40° and 60° south, with a constancy similar to that of the prevailing westerly winds. It is especially noticeable in the Pacific between 45° and 55° south, and from Tasmania and the south point of Stewart Island (New Zealand) to about 118° W., where a portion breaks off and forms the Menton current, which moves to the N.E., towards St. Ambrose Islands. The greater part, however, of the main current continues to the eastward, as far as about 85° west, where the southern branch divides into two currents between 42° and 47° south, one bearing to the north-east, forming the Chili current, and the other tends to the E.S.E. and S.E., toward the Gulf of Peñas and Straits of Magellan, and forms the Cape Horn current."

Borne away upon Antarctic currents, the icebergs drift into lower latitudes and melt in warmer water. The icebergs which leave the Antarctic continent at 63° or 65° S. "experience little change by the melting process until the 60th parallel is reached." It is commonly thought that they melt most rapidly under water, and "the change of center of mass and shifting of berg into new positions of equilibrium, undermining, fracture, etc., causes irregular and fantastical shapes." This change of center of mass and the exposure to view of new surfaces is probably often due to the loosening and letting go of huge rocks, boulders and stones imbedded in the berg, since "icebergs, like glaciers, are great transporting agents," bearing away to the deep sea these solid substances.

It is difficult to arrive at the average size of these bergs, as they are reported of all sizes, up to 800 or 1000 feet in height and up to several miles in length. The shapes of the bergs are also reported as being of almost every conceivable form, but in the southern oceans the bergs, as a rule, do not have so frequently the towering spires that are often a characteristic of those seen in the northern oceans, but are comparatively flat-topped.

The icy barriers have been reported to have the appearance of vast chalk cliffs, and "it is a question whether the discontinuous coast-lines constitute parts of a continent, or whether they are, like the coast of Greenland, portions of an archipelago, smothered under an overload of frozen snow which conceals their insularity." "It is calculated that the center of the polar ice-cap must be three miles deep, and may be twelve miles deep, and the material of this ice mountain being viscous, its base must spread out under the crushing pressure of the weight of its center." "This extrusive movement thus set up is supposed to thrust the ice cliffs off the land at the rate of a quarter of a mile per annum."

Mr. Findlay explains the difference in appearance of icebergs in northern and southern oceans as follows: "In the north they are formed on a limited space of land, chiefly Greenland, and here the land ice reaches the sea down narrow fiords in the form of glaciers, literally rivers of ice, whose outflow into the sea is constantly disrupted, and in the spring the masses drift southward in every variety of size and figure except the tabular. In the south, on the contrary, the whole of the south pole appears to be encircled with land covered with this tremendous icy mantle, without any inlet into its interior, as in the case of the Arctic regions, unless there should be such south of Cape Horn, and thus there is no influx of warm water which can penetrate into the rear of the icy barrier (as is the case in Baffin's Bay and around Spitzbergen) to dissolve and drift it out in a similar way."

The motion of an iceberg is a compromise motion of wind, surface current and undercurrent. The southerly gales in the Antarctic region, due to the cold air caused by the presence of glacial formations settling down and squashing out, is probably the greatest factor in causing a strong surface current, which has much to do with the northern movement of the berg.

Drifting to lower latitudes through the effects of currents and winds, "as the distance from their birthplace increases, they are

found in all stages of decay. Some apparently retain their original form until they reach comparatively low latitudes, and others appear to have changed entirely," having overturned, as some say, but more frequently broken up. In connection with this breaking-up of bergs, and illustrative of large numbers of bergs sometimes seen, and of the danger from loose ice in passing to the leeward of a berg, and the unreliability of the thermometer as an indicator of the nearness of ice, the following extract is given from the report received at the Hydrographic Office from Captain A. John Miller, British bark Lindores Abbey, from Portland, Oregon, to Galway: "February 8, 1893, at 6.30 P. M., in latitude 50° 50′ S., longitude 48° 17′ W., we saw a large iceberg about a point on the port bow; from the fore-topgallant yard we could see several others ahead and on the starboard bow; at 8 P. M. we were up to the front one and could then see a number of others. We were favored with very clear weather and a steady breeze from W.S.W. to W.N.W., going about 7½ knots an hour, steering N.N.E.; during the night and all next day we were passing through between these large bergs, which we could see on both sides as far as the eye could reach, some of them over a mile long, and ranging from 150 to 200 feet in height. From 1 P. M. to 4 P. M. (three hours) I counted 63 large bergs, besides numbers of small ones. While passing some of them we heard them crack and saw pieces falling off them, the noise being like the report of artillery firing; while passing close to leeward of the large bergs there was always a lot of loose ice, large enough to be very dangerous to ships in the dark, as it was almost flush with the water and difficult to see at night; when right to leeward of the icebergs we invariably got a strong gust of wind off of them, just like squalls off highlands, strong enough to make us lower our royals sometimes; at 8 o'clock on the evening of the 9th of February we passed the last large iceberg, having been just 24 hours among them, and having sailed about 180 miles through them in a northeasterly direction. At 5.30 next morning we passed three small pieces of ice, but saw none during the night, nor have we seen any since. While passing through this vast field of ice there was no perceptible change in temperature of either air or water, the thermometer showing air 46° F., water 44° F. It was a grand sight, especially at sunrise, and one never to be forgotten by those on board."

As to size of icebergs sighted in the southern oceans, Chief Officer Cummings, of British bark Beechwood, reports to the Hydrographic Office that "on the 6th of December, 1893, they met with a number of icebergs in lat. 40° 43′ S., long. 42° 28′ W. Through these navigation was extremely difficult. Great precaution was taken at night, sail was shortened during the night, an incessant lookout kept to prevent collision with any of these frightful obstructions to clear sailing. On December 7th, lat. 47° 7′ S., long. 41° 44′ W., other bergs were encountered, necessitating renewed vigilance. On the same day a monster berg hove in sight. It was a mighty mountain of ice, moving slowly in solitary grandeur among the great Atlantic waste." Captain Mansus, master of the Beechwood, and Mr. Cummings, chief officer, estimated the length of this appalling mass of ice to be 15 to 20 miles, and its height 300 to 400 feet. The captain of the Drumcraig also reports to the Hydrographic Office that "on December 29th, 1892, in lat. 49° 34′ S., long. 45° 53′ W., he sighted a large ice island fully 300 feet high and 25 or 30 miles long." These dimensions are wonderful, but not of more than half the horizontal dimensions of the body of ice which Mr. Towson tells "was passed by 21 ships during the five months of December, 1854, and January, February, March and April, 1855, floating from lat. 44° S., long. 28° W., to lat. 40° S., long. 20° W., with a height not exceeding 300 feet, but of horizontal dimensions of 60 by 40 miles. It was reported to be of the form of a hook, the longer shank of which was 60 miles, the shorter 40 miles, and embayed between these mountains of ice was a space of water 40 miles across." When we consider that only about one-ninth of the mass of an iceberg is above water we wonder at their magnitude and source, and yet we can more readily imagine their source when we recall the fact that "Sir James Ross followed the line of the enormous ice cliffs in the Antarctic regions for 450 miles and more, which had an unvarying height and character, calculated to be upwards of 1000 feet in thickness." Similarly, Capt. Wilkes "in some places sailed for more than 50 miles together along a straight and perpendicular wall of ice from 150 to 200 feet in height."

Among the Hydrographic Office files is an interesting report from Captain Doan, of the American ship Francis, which I give in full:

"February 16, 1893, at noon, lat. 51° 01′ S., 49° 15′ W., we passed between two large icebergs, about 15 miles apart, and saw to the S.S.E. of us another *very* large berg several hundred feet high and a mile or more in length. Put the ship under easy sail for the night. At 1 A. M., 2.30 A. M. and 4 A. M. passed large bergs. Weather cloudy and misty. Wind hauling to N.W. Soon after 4 A. M. it began to get daylight, when we saw before us an immense barrier of ice, extending from N.W. to S.E., as far as we could see from aloft. Some of the floating glaciers were miles in length and from three to five hundred feet high. Stood to within a mile of the track, but seeing no safe passage through the barrier, we wore ship to southwestward at 5 A. M. We now saw icebergs all about us. Temperature of air and water from 47° to 50°. At noon wore ship to northward, passing a number of large and small bergs. At 3 P. M. saw the barrier again, to leeward, still continuing its line from N.W. to S.E. and as impenetrable as before. Stood on till 5.30 P. M., and as the ice was visible to N.W. (2 points off weather bow), as far as we could see from aloft, we again put the ship on the southern tack. Wind hauling to S.W. and steadily increasing to a moderate gale. Now having the ice fields for a lee shore was anything but pleasant to contemplate during the long night watches. February 18th, midnight, wore ship to W.N.W. Reefed upper foretopsail, furled upper mizzen. Rough sea. At daylight we saw a berg ahead about one mile long and three or four hundred feet high. It was perfectly level on top, and its sides and ends were as perpendicular and clean cut as the blocks of ice taken from our lakes and rivers at home. It is also apparent that these immense pieces of ice are in the same condition as when first broken from the main glacier, as the irregular angles of the smaller bergs indicated that they had turned over occasionally. At 11 A. M. saw the dreaded barrier again, still extending to N.W. At noon our position was lat. 50° 29′ S., long. 47° 12′ W. Found we had a very strong N.E. current setting us towards the ice, adding another factor to the manifold dangers by which we were surrounded.

"At 1 P. M. judged we could see the end of the barrier to the N.W., or about 1½ points off our bow. Gave the good ship all the sail she could bear and pushed her through a very large and turbulent sea, caused partly by the deflection of the strong

N.E. current against the large mass of ice under water (the pack being from two to four miles to leeward).

"We now had the satisfaction of seeing the ship steadily draw past the last fearful piece of this gigantic ice field, which we found by careful measurement by the patent log was just six miles long and, as near as we could judge, it was three or four miles wide. This would give an unbroken area of 18 or 20 square miles, between three and four hundred feet *above* the sea. (At 4.15 P. M. passed the N.W. point of ice, lat. 50° 13′ S., long. 47° 23′ W. Saw the ice extending away to N.E., but no more in our vicinity.)

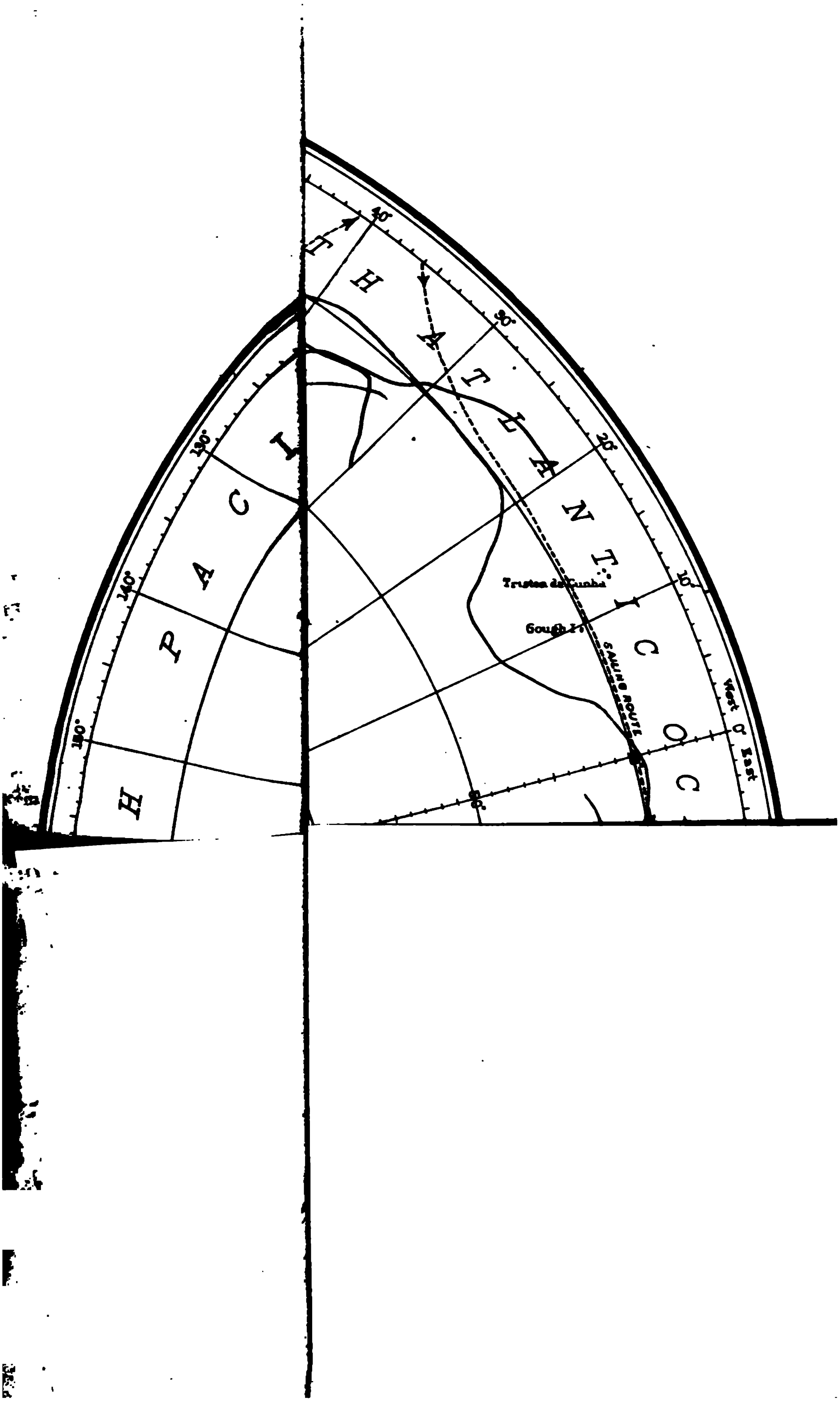
"Too much notice cannot be given to our mercantile marine of this great danger that lies directly in the fair way of vessels bound eastward around Cape Horn, as it will doubtless take years before such a mountain of ice (such as I have described) to be destroyed, and that was only one of many more that *we saw* in this ice field, extending from lat. 50° 13′ to 51° S., long. 46° 45′ to 47° 23′ W., and how much beyond I am willing to leave to some other navigator to tell."

Referring again to indications of approach to ice, many ways have been suggested; especial reliance upon the thermometer is often advised, but while in many instances this would no doubt prove useful, yet we have some reports showing that the thermometer cannot always be relied upon to indicate the proximity of ice. Besides the report previously referred to, we also have the following from Captain McMillan, of the British ship Dudhope: "Careful thermometric observations of air and water were regularly taken, but our approach to ice, always from windward, was not once indicated by any appreciable change of temperature in either air or water. On passing to leeward of the bergs a fall of a few degrees was generally observed *in the air.* On one occasion we passed within a cable's length of a berg and found the temperature to be the same there as at several miles distance. This would go to show that in thick weather, or in any other, even temperature and thermometer at normal height should not be accepted as a reliable guarantee of immunity from ice. Care and a most vigilant outlook are the only reliable safeguards. To depend on the thermometer would mean disaster, as I am convinced that a ship would be too close to the ice to extricate herself by the time the thermometer would indicate its presence."

As has already been stated, there are years of very few or no icebergs, and then years when great numbers are reported. In the year 1832 the southern ocean was so covered with icebergs that a number of whaling vessels, bound round Cape Horn, encountering them, put back to Valparaiso to await a more favorable season, because it appeared too dangerous to undertake the voyage. Again in 1854 there was a great accumulation of icebergs, and now during the past few years, notably 1892 and 1893, there has been another notable output from the great berg factories of the Antarctic regions. During the intervals between these periods there have been very few bergs reported. What causes this occasional great accession of bergs? Some authorities offer as a probable explanation the breaking off of the ice margin by volcanic eruptions, and others that earthquakes cause numerous pieces of the glacier to become detached and set adrift as icebergs, and others that unusual heavy annual snowfall is favorable for increase in number of bergs. The rapidity of glacier movement seems usually to regulate the number of bergs cast off. If the ice at the bottom of the glacier moves so slow that the melting of the margin on coming in contact with the salt water equals the advance, then we would have no icebergs, except perhaps those breaking off from the upper part of the outer margin, and these would be comparatively small.

In order to obtain facts for study, charts have been compiled from reports deposited in the Hydrographic Office, Department of the Navy. Through the courtesy of Commander C. D. Sigsbee, Hydrographer, I was permitted to use the files of the office. Out of several thousand meteorological reports examined, 307 reports of ice in the southern oceans were found, and upon these the charts are based. For the years 1892, 1893, 1894, and 1895 a large number of reports was found, especially in 1893 and 1895; while in the other years, notably 1888, only one or two reports of icebergs sighted were found, although about the same number of reports of vessels going over approximately the same route was carefully examined. The conclusion from this is that during the years 1888, 1889 and 1890 there were comparatively few icebergs in the southern oceans.

There are two charts, one representing the seasonal iceberg limits, together with approximate sailing routes to various points, and the other showing by different colors the icebergs



Tristan da Cunha
South I.
SAILING ROUTE
West 0° East
10
20°
30°
40°
50°
130°
140°
150°

reported in the different seasons throughout the period under discussion. It must be understood that the routes do not by any means represent the various routes taken by vessels whose course is determined by the direction of the wind. On the seasonal chart the icebergs plotted in red are those sighted in June, July and August; in blue, for September, October and November; in green, for December, January and February; in yellow, for March, April and May.

The charts deal entirely with icebergs and not with other forms of ice, such as field ice or ice floes. They give a graphic presentation of reports of icebergs seen during the different seasons, and convey a general idea of the number and positions of icebergs. The chart of limits may serve as a "practical guide to mariners as a warning in approaching the regions where especial vigilance is essentially required." On the chart of icebergs the positions of bergs are plotted as nearly as practicable as reported, and when too numerous to plot, the number is given, or, if no number, but "numerous," or "large number of bergs," is reported; the letter "L" is placed by the side of a berg in the color corresponding to the color used for that season. In a few instances, where bergs are reported as "fast breaking up" or "rotten-looking," a note is made on the chart.

From plotting upon the chart the icebergs reported in the months of December, January and February during the years from 1891-1895, distinguishing by symbols the bergs seen in different years, it has been found that the greatest number was reported in 1893 and 1895, with a smaller number in 1892 and 1894, and the smallest number in 1891. We find groups of bergs south of Cape Horn, east and northeast of the Falkland Islands, and south of Africa, and a line of bergs stretching to the eastward near the 45th parallel, with the most easterly one, in January, 1892, on the 75th meridian east, while to the west of Cape Horn, in 1892, we find a line of bergs extending along near the 55th parallel from 100° W. to 135° W. The greatest frequency is in December and January, and the lowest latitude reached is in December and January, 1893 and 1895.

From a similar chart for March, April and May, the months of March and April, 1893, have the greatest number, with no reports for 1888, 1889 or 1894. The principal group is east and northeast of Falkland Islands, and is entirely for the years

1893 and 1894, while the group for 1895, south of the Horn, has become much smaller. The most easterly report is in 32° 30′ E. and 42° 30′ N., and the most westerly one is near the 50th parallel and 135th meridian west.

On a chart for the southern winter season, June, July and August, we find all the years under discussion represented except 1888 and 1889, with the greatest number in 1892. There is a group immediately south and near Cape Horn, and another large group between 40° S. and 45° S. and 30° W. and 40° W., and still another large group between 40° S. and 45° S. and 25° E. and 30° E. There is also a line of bergs reported in July, 1895, extending from 44° E. to 67° E., near the 45th parallel. There is a small group reported in the same month and year near the 55th parallel and 160th meridian W. A large group of bergs was reported in July, 1892, in the remarkably low latitude of 37° S. and near 42° W.

On a chart for September, October and November we find a large group of bergs south of Cape Horn, and it is seen that this group is made up entirely of bergs sighted in 1895, with the exception of two bergs reported in November, 1891. East and northeast of the Falkland Islands we find all the years represented except 1891 and 1894, with only one report each for 1888, 1889 and 1890. Near the 40th parallel, and from 0° to 5° E., there is a large number reported in 1893 as "low, rotten-looking bergs, fast going to pieces." This is the only season in which we have any bergs sighted in 1888. The chart for this season is remarkable for the years represented, as well as the east and west limits. Bergs were reported in 1893 at 180° W., and in the unusually low latitude for that part of the ocean of 42° S., near which position 78 icebergs were reported. We also find a group in 1893 near the 45th parallel and 160th meridian E.

The accompanying "Chart of Ice Limits for the Four Seasons" shows the northern limits reached by the ice in the different seasons; the limit for December, January and February is shown in green; for March, April and May, in yellow; for June, July and August, in red; and for September, October and November in blue. The broken black lines indicate approximately the sailing routes to various points. The ice-limit lines are shown only where ice has been reported during the season

considered. From this chart it appears that the greatest northern limit reached in the South Atlantic for the period under discussion was in the season of June, July and August, reaching to about 37° S., near the 20th meridian W. This limit is nearer the equator than the usual summer limit of the northern ice, as we find by an inspection of the ice charts published on the North Atlantic Pilot Chart for June, 1894, covering a period of seven years, that the lowest southern limit is 40° N., and near the 50th meridian. A few bergs are shown in the chart of limits north of Falkland Islands, and are not enclosed within the limits shown. It is an unusual position for bergs, but the surface current near the islands shows that they might easily have been drifted to the position shown.

In July, 1895, a number of bergs were reported between the Cape of Good Hope and Australia, but none reported after that, except one berg in November near 45° S. and 50° E. This sudden disappearance of the bergs may have been caused by rapidly breaking up, but probably by having been driven by heavy winds causing a strong set of the current toward higher latitude and out of the track of vessels.

An inspection of the chart would seem to show that the bergs are formed at several different special parts of the Antarctic Continent, and are then, by the compromise force of wind, surface current and undercurrent, drifted northward, then northeasterly, and then easterly. If we should be fortunate enough to get reports for the years under discussion from higher latitudes it might be possible to trace back, from the group of bergs, to the Antarctic lands, and find the approximate place of formation of these groups.

The life of a berg in the southern oceans is probably much longer than that of one in the northern ocean, since they are larger and more compact, and as we have seen, drifts to lower latitudes in the South Atlantic than those in the North Atlantic. Mr. Towson states that "in January, 1850, an iceberg was within sight of the Cape" (Good Hope), "and that in April, 1828, and in August, September and October, 1840, there were several icebergs in this locality." This is an unusual position for bergs, being 34° S. The northern limits of icebergs for the years of which this paper treats reach farther north over the whole southern ocean generally than at any period for which similar

deductions have been found. Some of the bergs sighted in the South Atlantic during this period have been reported as being earth-stained and discolored. This may have been due to the iceberg "exposing the side of some old crevasse, into which débris from a surface moraine has fallen."

To show the remarkable drift of pieces of these southern icebergs, the following extract is taken from a report received at the Hydrographic Office from the master of the brig Dochra: "On April 30, 1894, latitude 26° 30′ S., longitude 25° 40′ W., at 10 A. M., observed a piece of ice twelve feet long, four feet wide and four feet high; it was very white and seemed perforated. We passed quite near it; the sea was smooth and several people saw it."

It is to be hoped that the renewed interest in Antarctic exploration, now manifest in Europe, will bear good results, and that the bold explorers sent out will solve the question of the origin and nature of these gigantic ice masses. Knowing this, it will remain for shipmasters faithfully to report all ice sighted, together with observations of wind, weather, temperature of sea-water and air, currents, etc., before we can fully trace the history of the ice mass from the time of its first formation till it finally disappears in the waters of the temperate zones.

In the preparation of this essay, and in addition to the large number of ships' logs, I have consulted the following books, charts, etc.: "Antarctic Explorations," G. F. Griffiths, Smithsonian Report, 1890; "Glacial Geology," Prof. James Geikie, F. R. S., Smithsonian Report, 1890; "Deep-sea Deposits," A. Daubree, Smithsonian Report, 1893; "South Pacific Ocean Directory," fifth edition, A. G. Findlay, London, 1884; "Icebergs in the Southern Ocean," H. C. Russel, Sydney, 1895; "A Popular Treatise on the Winds," Ferrel, New York, 1893; "Theory of Winds," Capt. Charles Wilkes, Philadelphia, 1856; "American Practical Navigator," Bowditch, revised edition, Bureau of Navigation, Navy Department, Washington, D. C., 1896; "Climate and Time," Croll, Edinburgh, 1885; "Encyclopedia Britannica"; "International Ice and Derelict Code of Signals"; "The Liverpool Mercantile Service Association Reporter, 1895"; North Atlantic Pilot Charts for June, July and August, 1894; "Report of Ice and Ice Movements in the North Atlantic Ocean," Ensign Hugh Rodman, U. S. N., Hydrographic Office,

Washington, 1890; "Memoir of Danger and Ice in the North Atlantic Ocean," Bureau of Navigation, Navy Department, Washington, 1888; "Report of Ice and Ice Movements in Bering Sea and the Arctic Basin," Ensign Edward Simpson, U. S. N., Hydrographic Office, Washington, 1890; various reports on file at the Hydrographic Office, Navy Department, Washington, D. C.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TARGET PRACTICE AT SEA.

By Lieut. W. J. Sears, U. S. N.

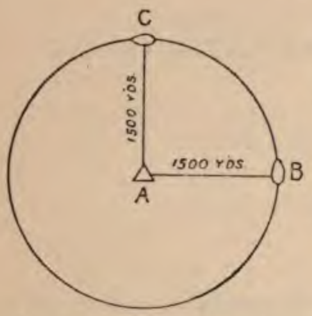
It appears from recent instructions in regard to the subject that it is considered possible to simplify the method of conducting target practice. This probably includes the preparation for practice, the method of obtaining data with which to prepare the records, and the reports of the practice, as well as the method of actually conducting it.

It may be assumed that the primary object of target practice is to teach the men to load and fire the guns quickly and accurately. The methods of obtaining data for keeping the records should, therefore, interfere as little as possible with quick and accurate firing. At the same time it is evident that at least a fairly accurate method of keeping the record must be used, or the interest in the practice will cease with the practice itself, and much of the benefit, for future use and reference, will be lost. Under ordinary circumstances extreme accuracy of observation is seldom attained, and great refinement in plotting is therefore hardly necessary. As much credit may be given then to the gun captain who hits a target two hundred feet long and twenty feet high as to one who makes a bull's eye, unless bull's eyes are his specialty and he makes them frequently.

It will probably seldom happen in action that the guns of our vessels will be fired with ships at anchor, except, perhaps, in the case of bombardment. It would, therefore, appear to be advisable to teach our gun captains from the beginning to fire from the ships while under way. Two methods will be proposed for this: 1st, one in which the bearing and distance of the target remain constant, or approximately so. This would take the place of the present stationary target practice. 2nd, one in

which both the bearing and range are constantly changing, as in our present moving practice.

First Method.



But one target is used, which is dropped overboard, when ready to begin the practice, at *A*. The ship then steams away from the target, say 1500 yards, and brings it abeam, as at *B*. She then steams around the target in a circle, with either port or starboard helm (according to the battery firing). All that is necessary to do this is to keep the target always bearing abeam. This method was recently used on board the San Francisco and was very successful, the ship maintaining a generally uniform distance of 1500 yards from the target, the limit of variation at any time being only about fifty yards. The target practice was excellent, and the fall of the projectiles about the target surprisingly uniform.

Observers.

Four observers are necessary, all on board ship, as follows:

One to take the time and number of the shots as fired from the guns in sequence.

One to note the range (so that the ship may be kept within the desired one, and also to furnish data for plotting); this may be done by Buckner's method or with the Fiske range finder.

One to observe the distance the shot strikes from the target, using Buckner's method.

One to observe the angle, right or left, from the target to the spot where the projectile strikes.

All shots striking at an angle of not more than $1\frac{1}{4}$ degrees to the right or left of the target may be considered (at 1500 yards range) as striking a target extending 100 feet to the right and left of the target fired at, provided the vertical distance is not too great or too small. For horizontal plotting, on a scale of one inch to twenty feet, the following may be used:

$\frac{1}{4}° = 1$ inch; $\frac{1}{2}° = 2$ inches; $\frac{3}{4}° = 3$ inches; $1° = 4$ inches; $1\frac{1}{4}° = 5$ inches (limit to target 200 feet long).

For vertical plotting, take the distance short, or over, from the target that the projectile strikes, from Buckner's tables; with these distances pick out the vertical co-ordinates from table III of the "Tables for plotting gun practice," now furnished to ships.

The data for this method is easily obtained without interfering with or delaying the practice in any way, the shots are quickly plotted and the record is easily made up after the practice is over. But one of the most important points with this method is that the firing is continuous from the moment of commencing with one battery until all the guns on that side have fired their allowance. The firing is therefore spirited, and a lively interest is taken in it both by officers and men. It is much more natural that this should be so than in a practice which is interrupted by the ship swinging (at anchor) so as to prevent certain guns from bearing on the target, or smoke hanging around the ship so that the target cannot be seen. At the same time the method is as simple as though the ship were at anchor. Still, it may be considered preferable to anchor the ship, and if so, desirable places are easily found in our own waters; but this is not always the case on foreign stations, and such places where target practice with great guns can be carried on without offense to or objection by foreign powers are sometimes found with difficulty, if at all. By dropping the target and steaming around it in an approximate circle, as just described, target practice may be had at almost any time when a ship is at sea. It also takes considerable time to anchor, send out a target, place the buoys now used on each side of it, and station the boat containing the right or left observer.

A disadvantage of the present method of stationary practice (and in fact of all methods of practice requiring observers in boats) is that a smooth sea is necessary to make the boat observations of any value. A smooth sea may ordinarily be found in such favored places as Long Island Sound, Gardiner's Bay, Chesapeake Bay, and around Key West. But on foreign stations it is otherwise, and considerable difficulty is sometimes experienced in finding a favorable place for target practice with our long-range guns. A case is recalled when target practice commenced under such circumstances on a foreign station. The sea was smooth, and there was but little wind. Shortly afterwards a moderate breeze sprung up, but there was not enough wind to interfere with the firing. The short, choppy sea gave the observers' boats considerable motion, however,

and it was found that their observations were of but little value in plotting the shots to make up the record. This could not have happened if the observations had all been made from the ship.

It is to be regretted that Buckner's method is the only one that appears at present to be feasible for the complete observation of fall of shots from the ship, as it is not very accurate, and for that reason probably has become obsolete. But it gives, perhaps, as good results as observations taken from boats, except under favorable circumstances, and it is not always convenient to wait for such conditions. If the method involving the use of Buckner's tables will give results sufficiently accurate to furnish data from which to draw conclusions to enable us to correct the gun captain's firing, and also make up a record with which to compare the various gun captains' marksmanship, it is sufficiently accurate for our purposes.

Second Method.

MOVING PRACTICE.

The objects in this method will be:

1st. To maintain a continuous, spirited firing from either the starboard or port battery from the time of commencing until all the guns of that battery have fired their allowance. The men would probably take more interest in the practice than they would if the ship steamed over a short range on one course for perhaps only ten minutes and then spent some little time to turn and get on the range to steam back. It is tiresome and uninteresting to stand at the guns waiting to fire.

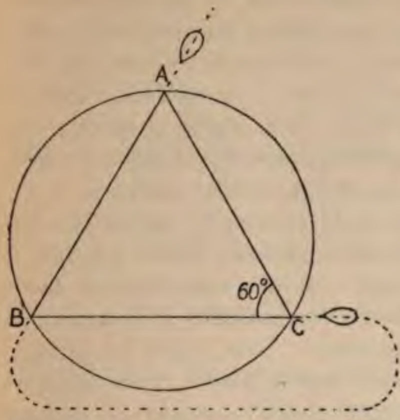
2d. To lay the targets out quickly and easily and commence practice with but little delay.

3d. To have practice at sea at almost any time.

4th. To use no boats for observers; practice can then take place under circumstances of wind and sea that would make it impossible to have it if boats were used.

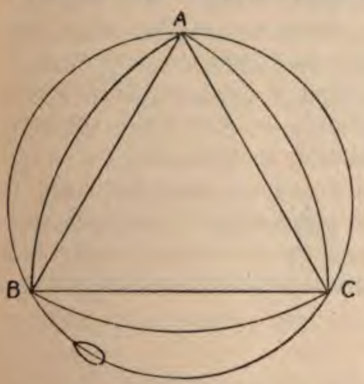
The system proposed is to use three floating targets, all alike, so that once dropped from the ship they will drift at about the same speed and maintain approximately their relative positions from each other.

Suppose the ship to be steaming along at a uniform speed, the first target is dropped, which we will call target *A*.



After steaming say 1500 yards on the same course, the second target, *B*, is dropped. The third target, *C*, is dropped by bringing either *A* or *B* on the proper bearing and steaming towards it until the angle between *A* and *B* (set on a sextant) gives the correct position to drop *C*. In the figure the ship is steaming towards *A*, where she drops the first target. Without changing course, she steams 1500 yards and drops the second target at *B*. She then changes course, as shown by the dotted line, and steams around until she brings *B* on the proper bearing, when she steams slowly towards it, keeping it on the proper compass bearing. When the angle between *A* and *B* is 60°, the target *C* is dropped; the ship then steams around all three targets, firing at them in succession until the allowance of ammunition for the battery on that side is expended. She then turns and steams in the opposite direction, mans the other battery, and fires until its allowance is expended.

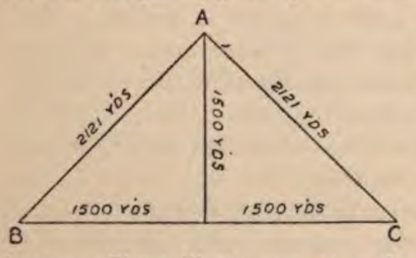
Suppose the starboard battery to be the first one to fire. After dropping target *C*, the ship steams in the direction of *B* and gets on the circumscribed circle. When she gets near *B*, she opens fire on target *C* at 1500 yards range, turning gradually towards *A* with a port helm. If she follows the circle, the distance steamed from target to target will be 1815 yards, and the greatest distance from the ship to the target fired at will be 1733 yards. But by following the inner arc of a circle, struck from *C* as a center, the distance from *C* would be constant, and



would be 1500 yards. This is a special case of the first method described, using a single target, and should be avoided to give the gun captains practice in training their guns. When the ship arrives at *A* the target *B* is fired at until *C* is reached, when *A* is fired at until the ship arrives at *B*. The same observers are required as in the one target method, already explained. The plotting is done in the manner described for that method.

On soundings, the targets could, of course, be anchored; but the advantage of the method (if there is any) would be that it could be used at sea off soundings under circumstances when observers in boats could only obtain observations that would be of but little value in plotting the shots. This might be of considerable importance on a foreign station where there may be difficulty in finding a good target ground outside of foreign jurisdiction.

It seems quite probable that objection will be made to the use of Buckner's method. But is the present method of observation and plotting always more satisfactory than this would be?



Suppose that with the present method a target is laid out at *A* and the ship steams over a range between two buoys, *B* and *C*, 3000 yards apart, at a speed of ten knots, firing at the target *A* while between the buoys. She will steam across the range in about nine minutes. Leaving or approaching a buoy at either end of the range, the distance from the target will vary 200 yards in less than a minute. The observations for plotting the fall of shots under these circumstances may not, perhaps, be any more accurate than those obtained by using Buckner's method.

The preceding is offered not in any sense as a criticism of present methods, but merely as a suggestion of methods that may, under certain circumstances, be more advantageously employed in target practice on board our cruisers, particularly on board those on foreign stations.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAPHTHA FUEL FOR WAR-SHIPS.

By Lieut. M. Vasilieff, Russian Navy.

Translated from the Russian (Morskoi Sbornik, August, 1896) by Lieut. John B. Bernadou, U. S. N.

In submitting a sketch of the development of the employment of naphtha fuel for war-ships, I do not pretend to say much that is new; but information on this subject is so little spread in our Navy that even an elementary sketch should contribute its share of usefulness, especially in view of the probable employment of naphtha fuel on ships of war in the very near future.

First of all, the naphtha serving to heat steam boilers should not be confounded with *raw naphtha* or *kerosene*. Both of these latter substances are easily inflammable, as they contain various more or less volatile hydrocarbons (on account of the presence of which they possess a characteristic odor), while the naphtha which we are now considering, and which is commonly called "mazūt,"* is the residue from the distillation of raw naphtha after the kerosene, benzene and other coal derivatives with low ignition points have been expelled therefrom. Naphtha residue is a yellow brown, thick oily liquid; its specific gravity and ignition temperature depend upon the degree of distillation to which the raw naphtha has been subjected, or upon the temperature at which the process has been conducted. For general purposes of navigation the residue is completely safe when it possesses a specific gravity 0.92 and an ignition temperature

* This substance is hereafter referred to in this translation as "naphtha residue."

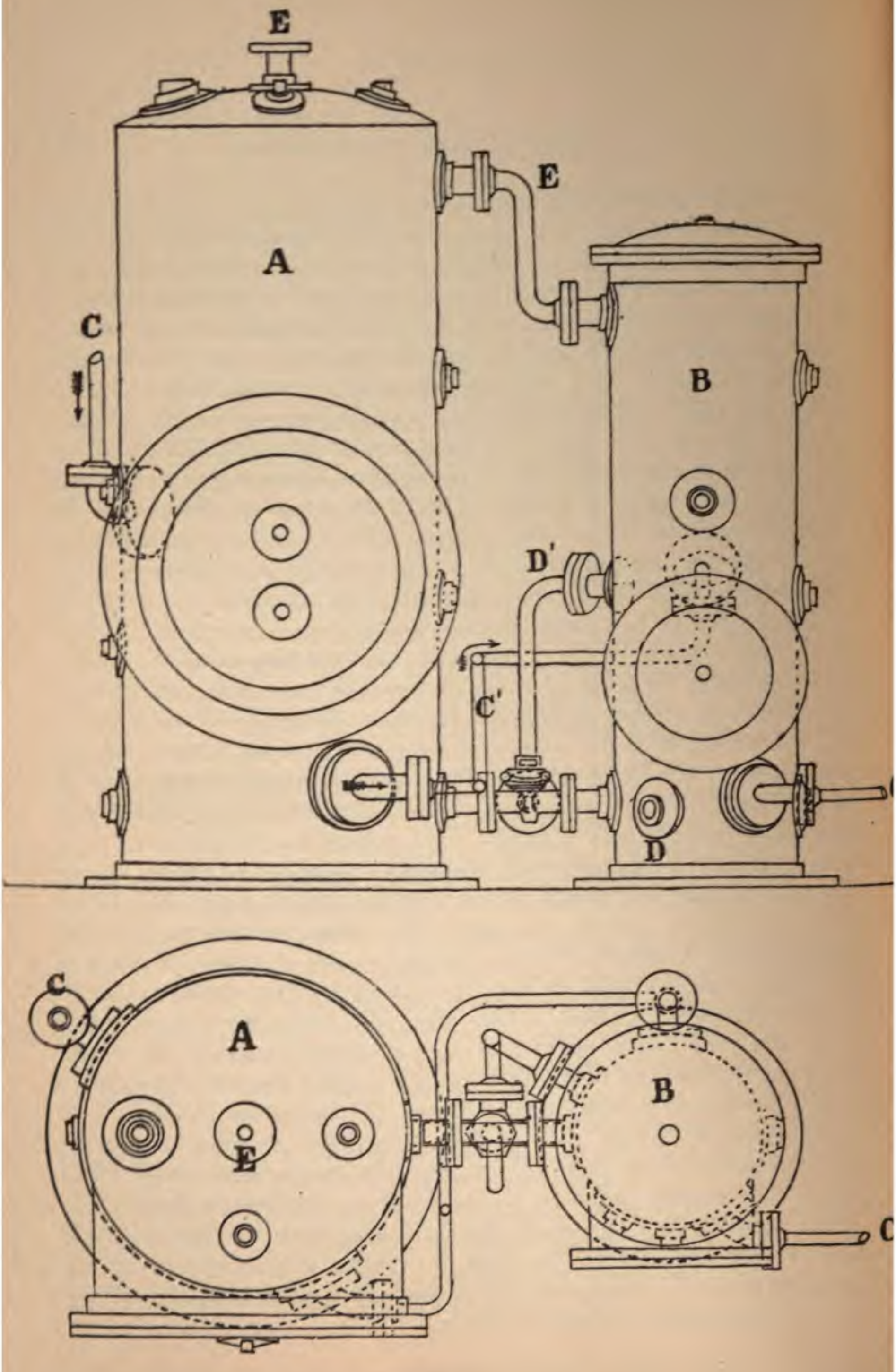
that is required. In a war-ship it is all-important to possess the capability of steaming the greatest number of miles with the given supply of fuel; therefore very economical burners would have to be employed, and besides, as all present-day types of steam boilers require to be fed with fresh water, the employment of steam from the boiler for the pulverization of naphtha would become a very serious obstacle to the application of liquid fuel on war-ships. The quantity of steam expended in operating the burners and lost by escape into the air through the smoke-stack amounts, with skilled firemen, to from three to five per cent. of the whole steam developed by the boiler; and no present-day type of fresh-water condenser is able to make the loss good. In this way there is presented to experimenters the option either to find a way of pulverizing naphtha besides that requiring the use of steam, or else to design a condenser capable of making good the loss of water caused by the burners. Following the first idea, burners have been proposed in which steam is to be replaced by compressed air, to obtain which ships' air compressors and accumulators are to be used; but by making a liberal allowance, the torpedo-boat Viborg, when running at mean speed, would require air compressors fifteen times more powerful than she carries, which, while very heavy, would occupy much room and would require additional attendance (all serious matters on a torpedo-boat). The compressed air itself, on its exit from the burners into the furnace, would lower the temperature of the flame through its expansion, which argues against the utility of this type of apparatus.

On the other hand the steam which is used for pulverization impinges at a high temperature upon the fire-brick lining of the furnace, dissociates, and the products of its combustion reunite to produce a flame of high temperature.

In May, 1895, at the commencement of the cruising of the torpedo-boat Viborg, information was received from our naval agent in England concerning an air compressor with uninterrupted action for burning naphtha which a London firm had gotten out. According to information furnished, this device was too clumsy and heavy for torpedo-boat use, and besides it delivered air at a pressure not high enough by one and one-half atmospheres, one which, even with the comparatively economical Petrashevsky and Shtchensnovitch burner, would only serve for mean speed.

The burners with mechanical pulverization make a somewhat better showing. With apparatus of this type the naphtha is preliminarily pumped into a special reservoir in which it is subjected to a pressure of between 75 and 100 pounds by a hydraulic pump; the stream of naphtha is driven at this pressure into the burner, where it strikes a specially shaped edge or rib which disintegrates it into dust. The Svenson burner, one of those constructed on this plan, was tried with some success last year on the Viborg; it gave a good flame and smokeless combustion, but could not burn the requisite amount of naphtha; before expressing a final opinion about it further experiments must be made, and the inventor is now at work on these himself. Fully comprehending that the best burner is one of the steam type, capable of being employed without requiring steam from the boiler to operate it, the officer in charge of experiments with liquid fuel, Captain, senior grade, N. X. Yenish, hit upon the idea of an evaporator in which the pressure of the secondary steam would be sufficiently high to operate the burners, the steam being formed so as not to interfere with the uninterrupted working of the latter. Such a device was designed* and developed at the establishment of R. Krug, St. Petersburg, and installed in the starboard fire-room of the torpedo-boat Viborg. This apparatus, called by its constructor a *high-pressure evaporator*, consists, as shown in the accompanying sketch, of two communicating copper cylindrical vessels, A and B; the first is the evaporator proper, and the second a heater for the feed water, which enters at the side through the tube D and flows freely by the tube D' into the evaporator A. Steam from the boiler enters the evaporator by the tube C and, passing through the coils (in series; not shown in the sketch), heats the water in A; then flows by the pipe C' into the feed water heater, where it is cooled and finally passes through C'' into the hot well. The pipe E' unites the steam spaces of both parts of the apparatus, in consequence of which the pressure and level of the water is the same in both. The secondary steam passes into the burner from the upper part of the evaporator by the tube E. Water glasses and cocks are provided for indicating the level of the water, while the pressure is indicated by a special gauge.

* With the aid of Shiloff, engineer-mechanician, who has done much work in connection with experiments on liquid fuel.



E
E
A
C
B
D'
C'
D
C
A
B
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C

As installed in the Viborg, the evaporator and mount weighed about 25 poods (1000 pounds), took up very little room and, although not provided with lagging, did not raise the temperature of the fire-room to any appreciable extent. In the following experiments made while under way the apparatus was fed with an artificially prepared solution of sea salt, of the density of sea water, with a boiler pressure between 90 and 95 pounds (250 revolutions, speed about 14 knots); the pressure in the heating coil of the evaporator was about 82 pounds, and of the secondary steam 40 pounds; the expenditure of feed water for operating both boilers (four burners) was about 59.6 gals. per hour, and the amount of naphtha burned was 33 poods (1320 pounds). The heating surface of each boiler was 107 sq. m. (1151 sq. ft.) For the general trial of the evaporator a run was made from Helsingfors and back to St. Petersburg; the results of these trials were reported as follows: "20 September, 1895, steam was gotten up in both boilers of the torpedo-boat, and when at 90 pounds the evaporators were started, commencing at the same time then to feed with artificial sea water (of density by salinometer of $\frac{1}{32}$ at 70° R.). The secondary steam from the evaporator was led into four burners, two of which were of the Petrashevsky and Shtchensnovitch and two of the Yanusheff system. The steam valves were opened wide. At first the evaporator showed by its action (as indicated by water glass and drain cock on pressure gauge pipe) that violent ebullition was taking place within it, which was accompanied with a projection of the water into the steam ducts of the burners. The projection of water stopped when the feed valve of the evaporator coil was partly closed. The causes of the violent ebullition of the water in the pulverizer may be taken as (1) the presence of a considerable quantity of dirt in the water, which came from the sea salt as purchased; (2) a too great ratio of heating surface to volume of water in the evaporator.

The salt water carried over by the secondary steam was deposited in the steam ducts of the burners, but was projected into the furnace without clogging them. The quantity of this water was so small that it exercised no injurious effect on the combustion of the naphtha in the furnaces. To form an estimate of the amount of deposit on the surface of the heating coils, the evaporator was blown through about every two hours, when nearly the

whole of the water in it was renewed. During the whole time of the trials the pressure of the secondary steam was maintained uniformly, and this pressure preserved a certain relation to that of the steam in the boiler; on increasing the latter the pressure was increased in the evaporator and *vice versa*. When the steam in the heating coils was maintained at a certain pressure by means of the feed valve, the variation of the pressure of the steam in the boiler did not produce a fluctuation in that of the secondary steam, which constitutes an advantage of this evaporator as an apparatus for effecting the pulverization of naphtha. The necessary regulation is easily effected by feeding in a constant and uniform supply of fresh water.* It is to be noted that the variation of pressure in the secondary steam did not depend upon the amount of naphtha consumed; the Petrashevsky and Shtchensnovitch burners did not smoke. During the feeding in of the feed water the pressure fell 3 or 4 pounds, but upon stopping the feed pump it immediately ran up again.

On blowing out all the water the pressure fell 10 pounds; on extinguishing the burner the feed valve was closed immediately and the formation of the steam stopped at once. The regulation of the supply of steam to the burners may be controlled either by the valves on the burners themselves or else by the feed valves to the hot water heater coils. This capability increases the efficiency of this evaporator as an apparatus for effecting the pulverization of the naphtha.

The torpedo-boat rolled heavily at the time of the trials of the evaporator, but the rolling exercised no influence upon its performance; the level of the water in the gauge glass showed that the foaming did not increase. During the second day of the trial the foaming of the water in the evaporator diminished, and the projection of salt water into the burners ceased nearly altogether; on the third day this projection was hardly noticeable. It should be noted that the foaming stopped when the surface of the heater coils became covered with a layer of scale, that is, when the quantity of heat and its speed of delivery to the water were reduced. After 30½ hours' trial the evaporators and the feed water heaters were opened, when it was found that the surface of

* Unfortunately the Viborg's feed pump was too large, in consequence of which it became necessary to stop it from time to time, so that the evaporator could not be fed uniformly.

the heater coils was perfectly clean, while the evaporator coils were covered with a layer of scale of a thickness of 1¼ mm. for the upper spirals, of ⅛ mm. for those in the middle, the lower coils showing scarcely a perceptible amount of deposit. This deposit did not impair the evaporative efficiency of the apparatus, and the fires continued to effect a smokeless combustion and to burn the same quantity of naphtha residue as they had burned at the beginning.

The scale can be easily removed from the upper spirals by jarring them with the hand, and from the lower ones by cleaning; to effect this the spirals are removed from the evaporator, which may be done easily and quickly. Speaking in general terms, the Krug evaporator, as an apparatus for effecting the pulverization of naphtha by steam, accomplished its purpose successfully during the whole of the experiments, and delivered to the burners a quantity of steam sufficient for the smokeless combustion of about one and one-half times the quantity of naphtha required by the torpedo-boat for running under forced draught.

Mr. Krug proposes to make certain improvements in later apparatus of this kind, such as (1) constructing the shells of the feed water heater and evaporator of steel instead of copper, as they will then stand greater pressure and, besides, will weigh less; (2) fitting both these vessels with salt water blow cocks, the need of which was felt from the beginning of the experiments; (3) introducing the feed water at the top instead of at the bottom after blowing completely through, so that the hot coils will cool throughout simultaneously and, through their change of form, will effect their own cleaning; (4) constructing the tubes of elliptical instead of circular section, so as to effect maximum deformation on contraction and expansion, etc.

Summarizing what has been stated above, the advantages that have been developed by trial for naphtha residue for fuel for ships of war are its safety as a combustible; its numerous advantages over and its superiority to coal as a fuel; the superiority of pulverization by steam over that effected mechanically or by use of air; and the accomplished development of a successful type of steam pulverizer, etc.

However, certain problems of secondary, yet of great importance remain to be solved, and experiments must be repeated upon a larger scale by way of verification of results already

obtained. One of these questions, propounded by Captain, 2nd rank, Gavriloff is worthy of a special mention. It relates to the effect of a submarine explosion upon the walls of a reservoir entirely filled with naphtha in which the pressure of the liquid is distributed equally in all directions. Systematically conducted experiments can alone determine how disadvantageous liquid fuel would prove in such a case and to what extent this difficulty may be overcome.

Further experiments will be made during the present summer with liquid fuel in the Baltic on board the Viborg, which has been definitely assigned to the work, and upon one torpedo-boat supplied with a Yarrow boiler. On the Black Sea a torpedo-boat is being fitted out for the use of naphtha residue (formerly the Novorossisk); and trials may be made on board the torpedo cruiser Kazarski and the ironclad Rostislav.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

DEVELOPMENT OF ORDNANCE AND ARMOR IN THE IMMEDIATE PAST AND FUTURE.*

By P. R. ALGER, Professor of Mathematics, U. S. Navy.

The object of my paper to-day is to bring to your attention and to discuss recent developments in ordnance and armor, and to point out the direction of probable further advances. Enormous strides have been taken by both the offense and the defense in naval warfare since the days of smoothbores and wooden walls, but there is room for further progress, and although this will probably consist almost entirely in the perfecting of details, yet to the navy most successful in doing this may come the reward of a decisive superiority.

It is an axiom that the success or failure of any mechanical device, complex or simple, lies in greater or less perfection of details, and this is perhaps truer of ordnance than of anything else. The best guns and mounts are useless if the primers or sights are defective; the best projectiles are of little value if their fuses fail. Of course the prime factors for success are skill and zeal on the part of those who handle the guns, but these qualities granted, then the difference between perfection and inefficiency lies in the working out of details.

Let us commence then with the gun and consider what is being done to increase its efficiency and what more can be done. The desirable qualities in a gun are safety, power, accuracy, rapidity of fire, and cheapness. Safety and cheapness depend upon material and method of construction; power depends upon

* The first of two lectures delivered before the Naval War College, Newport, R. I., in the summer of 1896.

size of chamber, caliber, and length of bore; rapidity of fire depends principally upon the system of breech closure; accuracy depends, as far as the gun itself is concerned, on workmanship.

Forged steel as a material and the built-up methods of construction are now in almost universal use, and the records of proving ground and service firings show that they furnish an ample margin of safety. Wire-wound guns are coming somewhat into use, but their superiority over built-up guns, either as regards safety or cheapness, is trifling or non-existent. I suppose no experienced person doubts that an efficient, safe and cheap gun can be made of cast steel or can be forged in one piece, but the manufacture of such guns can only be defended on the score of cheapness and rapidity of production, and they cannot be regarded as in any sense equal to guns built on the present system. It would appear, therefore, that there has been no important progress made in the art of gun-building in the recent past, nor is there likely to be any in the immediate future, and I think we need have no fear of our present guns becoming obsolete before they are worn out.

The power of any gun depends on its caliber, length, and the size of its powder chamber. Taking a gun of any given caliber, we can increase its power almost indefinitely by increasing the size of its powder chamber so that it will contain more and more powder, and at the same time increasing its length of bore so that the powder may have time to burn; but this method is so expensive, both as regards weight and money cost, besides involving increased difficulties in handling and supplying ammunition, that development along its lines ceased some years ago.

Universal practice has fixed the size of the powder chamber of modern guns at a point which permits the use of a brown powder charge of about half the weight of the projectile, which itself weighs in pounds about half the cube of the caliber in inches, and the serious disadvantages which would attend any very marked departure from this practice render a radical change improbable. The plan of increasing power by lengthening the bore, however, has of late been followed to an extent which seems to me to be unwise; based, as it appears to be, on mistaken notions as to the action of the new powders, whose introduction has been followed by the manufacture of guns of sixty and even eighty-caliber length. With the old brown powder an increase of length of

bore from 40 to 50 calibers adds but about 100 f. s. to the muzzle velocity of a large gun, and less than that to the muzzle velocity of a small gun; and with the new smokeless powders, for reasons which I shall point out later on, the gain from increase of length is even less. To compensate for this slight gain in velocity we have increased weight, cost and difficulty of manufacture, with decreased mobility. I think it quite certain that an increase of length of bore beyond 35 or 40 calibers is inexpedient and that there will be no marked future progress in this direction.

The true method of increasing power is by an increase of caliber, and the most important question in regard to the gun is whether we have reached the proper limit to development in this direction, or whether we shall find it desirable in the future to build larger guns than we now have in use or contemplation. Of late years the tendency has been the other way. Krupp and Armstrong no longer find purchasers for their 100 and 120-ton guns, and none of England's latest battle-ships carry the 16¼-inch gun. This retrograde movement was due to the fact that the power of the gun so exceeded that of armor as to render it advantageous to sacrifice the unnecessary excess for gains in other directions. The advent of hard-faced armor has put a stop to this movement, and the question now is, will future developments result in either a future decrease of caliber or a return to the largest calibers yet made and even an advance beyond them? There is no question as to the great advantages of large caliber; the larger the gun the more destructive in increasing ratio is its fire, but the sacrifices attending the use of very large guns lead us to restrict their use as much as the necessities of the case admit. If the 13-inch guns will suffice to do any work which they can be called upon to do, then we are not likely to build larger guns on the ground that the latter will do the work more easily. We must, however, have on our battle-ships guns capable of overcoming any defense which an opposing battle-ship may present to them. The question then is, are future armor developments likely to result in a protection to ships which the 13-inch guns cannot overmatch? No armor plate has ever yet been made which a good 13-inch projectile, at moderate range and with normal impact, would not perforate, and I incline to the opinion that there never will be. The power of the 13-inch gun is now limited by the strength of its projectile, which, unless

of the most superior quality, smashes on hard-faced armor, and it is more than likely that future advances in armor manufacture will be accompanied or preceded by equal or greater improvements in projectiles. I conclude, therefore, that an increase of power beyond that of the 13-inch gun will not become necessary, and consequently that no larger calibers will be adopted. As far as reduction in caliber is concerned, this would be clearly unwise at present, and even if, in the future, the 12-inch or a smaller gun develops sufficient power to overcome any armor, it is doubtful if the gain of weight due to the change will be of sufficient importance to justify it. There is no reason why the rate of fire of a 13-inch gun should not be practically the same as that of a 12-inch gun; its destructive effect is much greater; and, in my judgment, having adopted the 13-inch caliber for our battle-ships, we should, and will, continue its use in the future.

The most striking advance in ordnance in recent years has been the application of the rapid-fire principle to large guns, and it is very important to decide how far this development can be carried. We hear of 8-inch, and even 10-inch, rapid-fire guns, but the term should properly be applied only to guns using metallic cartridge cases. With such guns a quick-acting breech mechanism can be used, and the time required to prime the ordinary type guns is saved. Moreover, with calibers small enough to allow the use of fixed ammunition there is a considerable saving of time, from there being required but one motion in loading instead of two. Thus it is that the modern R. F. gun of 5-inch caliber or less can be fired in practice and without aim at the rate of 10 or 12 shots a minute; or, allowing about ten seconds for aiming, we may say that the service rate of fire of the 5-inch R. F. gun should be from 3 to 4 rounds a minute. When we go to the 6-inch caliber, where the weight of fixed ammunition would require two men to handle it, the advantage of single loading is lost, but still the saving of time from the use of the primed cartridge case is considerable, and with a well-drilled crew the service rate of fire of the 6-inch R. F. gun should be from 2 to 3 rounds a minute. The 6-inch R. F. gun is in general use already, and its great advantages over the ordinary type gun of equal caliber are now universally admitted. Can we hope to extend the R. F. system still further, or has the limit of progress in this direction been reached?

The interval between rounds with any gun is made up of

(1) the time to open breech, (2) the time occupied in cleaning gun or mechanism, (3) the time to load projectile, (4) the time to load charge, (5) the time to close breech, (6) the time to prime, (7) the time to point and fire. Considering the 8-inch caliber, let us see how these times can be reduced to a minimum and to what limit they tend. With our present breech mechanism the operations of opening and closing the breech occupy 4½ seconds each. The automatic opening of the breech during counter-recoil, which is now being used on heavy guns abroad, will save 4½ seconds time. The adoption of a mechanism actuated by a single motion, such as used on the regular R. F. guns, would save perhaps 7 seconds, 3½ in opening and 3½ in closing, but would necessitate the use of a metallic cartridge case which, as will be seen further on, has more than compensating disadvantages. Sponging or in any way cleaning out bore or chamber is an entirely unnecessary waste of time, and the only thing which should be done after each fire is to wash off the gas check with a marine sponge, which can be done while the gun is being loaded. The gun should also be primed while being loaded. The use of a primed cartridge case would, therefore, not save any time as far as these operations are concerned, neither would the use of a cartridge case save any time in loading; fixed ammunition is entirely impracticable for so large a gun as the 8-inch, so that double loading is a necessity. The use of a metallic cartridge case certainly would not make the operation of loading any more rapid, adding, as it would, some 50 pounds to the weight of the ammunition and requiring extraction and removal after each round, while at the best only saving some seven seconds on time of opening and closing breech.

The time taken to load shot and charge and to point and fire depends upon the efficiency of the ammunition, handling and gun-pointing apparatus, and upon the skill of the gun's crew, but the latter is by far the most important factor. As an illustration of this it may be said that the firing interval of our 8-inch turret guns at target practice ranges from 2 minutes to 8 or 9 minutes on different ships having the same mechanical arrangements, and, be it remarked, with far greater accuracy of fire on the ship with the smaller interval.

We must conclude, then, that with the 8-inch caliber, and *a fortiori* with larger calibers, no material increase in rate of fire can be attained by mechanical improvements in the guns them-

selves or by the use of the rapid-fire principle. The real progress in this direction in the future will be the result of constant and zealous exercise far more than of mechanical improvements.

When you read that the Elswick R. F. 8-inch gun has been fired, on shipboard, 3 rounds in 30 seconds, beginning loaded, you must not conclude that the Elswick 8-inch gun is superior to our own, for this is not the case. The true explanation is that the men who did the firing were well drilled and working for a record under intelligent supervision, and with equal zeal and an equal amount of practice our 8-inch gun's crews would do as well.

When we leave the 8-inch caliber another condition arises, *i. e.*, the weight of the projectile becomes too great for convenient hand loading. With 8-inch guns the projectiles should be kept about the gun, in racks or otherwise, and loaded entirely by hand. With the larger calibers the shell must be hoisted from below, together with the powder charge, and loaded by mechanical means, and the rate of fire depends almost entirely upon the efficiency of the ammunition-hoist and the skill of the men handling it. A small saving of time can be effected by automatic opening of the breech during counter recoil, but this amounts to about 15 seconds at the most; and the gain which will result from acquired skill in loading and pointing is far more important. No attempt should be made to clean bore or chamber. There is no danger of burning material being left in the chambers of the long guns now in use, and the difficulty of sticking of the shot in loading can be overcome by the use of a loading shoe which lifts the axis of the projectile to the same level as that of the bore. A well-drilled crew should be able to fire the 10-inch gun at the rate of one aimed round every two minutes, and the 12 or 13-inch guns every three minutes or less. The greater rapidity of fire of the 10-inch caliber is largely due to the fact that the half-sections of the powder charge are not too heavy to be removed from the hoist by hand and inserted in the powder chamber while the hoist is being lowered for another round. With the 12-inch and 13-inch this method, though perhaps practicable, has not been tried, and consequently the estimate is made on the supposition that the hoist has to be stopped in three successive positions while the shot and the half-charges are successively rammed home.

To sum up, it may be said that rapidity of fire with heavy guns depends far more upon the skill to be acquired by constant prac-

tice than it does upon further perfection of mechanical details. No man can properly control the ammunition-hoists and the elevating and training gear of a heavy turret gun unless he has learned to do it by constant exercise, and when we consider that the victory or defeat of a battle-ship will depend almost entirely upon the greater or less skill with which her turret guns are handled, surely there should be no lack of such exercise. Daily drill in handling all the mechanical appliances, and especially in pointing the guns at moving objects, should be absolutely insisted upon on every ship in our Navy, and the larger the guns the more necessary this daily drill is.

The next point to be considered is the possible increase of efficiency of gun mountings.

One considerable improvement has just been made in the carriages for broadside guns, namely, the adoption of what is known as a pedestal mounting, which enables the usual arc of train to be attained with a smaller port opening than with former mounts, and, what is of great importance, without the use of sponsons.

The most important change, however, is the extension of hand-working to the largest guns. The 12-inch guns of the Iowa will have hand-worked mounts, and so probably will the 13-inch guns of the new battle-ships, and it is well to consider how this is accomplished and just what the advantages and disadvantages of the system are.

In the first place it must be borne in mind that hand training is and always will be impracticable for heavy guns in thick-armored turrets. The Indiana's 13-inch turrets, for example, can be trained at a speed of 10° a minute by eight men when the ship is on an even keel, but the least heel will render it impossible to move the turret from the position of train on the lee beam. In future designs the turrets will be so nearly balanced as to train with about equal ease on an inclined or a level deck, but the slowness of the movement and the speedy exhaustion of the men on the cranks must always operate as a bar to the use of hand training, except in an emergency when the usual training machinery has been injured.

In the same manner, though not quite so decidedly, we are prevented from using hand power for hoisting ammunition and for loading. Rapidity of fire is too important to be sacrificed to the extent which would necessarily be the case should power hoists and rammers be dispensed with.

use in all guns, then, we appear to have come near to the probable limit to the power of the gun, as well as near to the probable limit to rapidity of fire.

But have we yet reached the point where it can be said that we have a reliable smokeless powder? Evidently we have not such a powder in service use, and the most that can be said is that the goal is in sight.

The fact is that almost all the known varieties of smokeless powder are unreliable, deteriorating after a time and gradually decomposing, and it is the fear of the results of such decomposition, when large quantities of the powder are contained in closed tanks or cartridge cases, which has operated to prevent their general service use.

It is probable that the French, who were the first to develop a smokeless powder, are to-day the only nation having a perfectly reliable one. They have in service use in all their guns a pure gun-cotton colloid, and we are endeavoring to follow in their traces.

The English cordite, which contains 58 per cent. of nitroglycerine, is commonly reported to be unreliable, though they have had sufficient confidence in it to issue it to the service.

The reason why we prefer to follow the French example is that we consider any powder containing nitro-glycerine unsafe. It is thought that in such a powder as cordite the nitro-glycerine is held in the colloid of gun-cotton as water is held in a sponge, and that pressure will cause the nitro-glycerine to exude, in which case even a slight shock will produce detonation. Moreover, it is thought to be impossible to make a really stable combination of heterogeneous nitro-substitution products; the interaction of the nitro-glycerine and gun-cotton and of the impurities in each will result, especially at high temperatures, in a slow decomposition and increasing instability. Gun-cotton, on the other hand, we know from many years of experience to remain unchanged through long periods of exposure to varying temperatures, provided it be kept wet. Now the form of a gun-cotton colloid protects its substance from the air much as water protects wet gun-cotton, and consequently there is every reason to suppose that it will remain unchanged if properly made. Again, the temperature of combustion of nitro-glycerine is much higher than that of gun-cotton (3469° C. to 2710° C.), and this

results in greatly increased erosion of the bore when nitro-glycerine powders are used.

With regard to the common notion that with smokeless powders great length of bore is desirable—this is certainly not the case with gun-cotton powders; 50 pounds of gun-cotton will do about the same work as 100 pounds of powder, and its combustion will develop about one and one-half times the volume of gas at about the same temperature. Consequently, if used in the same gun in this proportion, the gun-cotton will evidently produce a much higher maximum pressure if it burns as rapidly as the powder, or, if made to burn more slowly, it will produce a much more sustained pressure. But when all the charge is consumed the pressure of the gun-cotton gases will fall off much more rapidly than will that of the powder gases, because out of the 100 pounds of powder are formed 56 pounds of solid or liquid residue, from which the 44 pounds of expanding gases extract heat which keeps up their pressure, while the 50 pounds of gas from the gun-cotton has no reserve heat to draw upon. In other words, with a gun-cotton powder the maximum pressure is carried further along the bore than with an ordinary powder, but when the gas ceases to be evolved the pressure falls more rapidly, and at the muzzle of a 40-caliber gun the pressure is less with the former than with the latter.

Turning our attention next to the projectile, let us regard this as the vehicle for the energy of the gun. By the use of smokeless powders we have greatly increased the amount of energy which the projectile conveys, and by the use of Harveyized armor we have greatly increased the amount of energy required to overcome resistance to perforation. The next step, and a most important one, is to so improve the projectile that it shall be able to deliver the whole energy of the gun in the form of work done on the armor plate. Neglecting the work lost in overcoming the resistance of the air in flight, the projectile of course delivers the whole energy of the gun at the point of impact, but the manner of distribution of that energy is all-important. If the projectile is strong enough to bear the impact unbroken and undistorted, then all its energy is usefully employed in perforating or cracking the plate; but just to the extent that it breaks or is distorted, its energy is dissipated in useless work upon itself. Now the A. P. projectile within a few

a radical nature, but there is one direction in which popular opinion believes an advance amounting to a revolution will some day be made. Many people think that the use of high explosive shell will revolutionize naval warfare, and that the adoption of such shell for service use only awaits the appearance of the great *American inventor* who will reveal the secret of how to use them safely. There is so much misconception on this subject that it seems worth while to consider it at some length. The danger in firing any explosive from a gun lies, of course, in the possibility of its going off in the gun and bursting the latter, and the greater the quantity of the explosive the more likely is it to go off and the more serious will be the effects of such an accident.

Whatever be the character of the gun, the explosive must be contained in some sort of a projectile, and that projectile must be given velocity by some sort of an accelerating force, be it the expansive force of compressed air or of powder gases, and the acceleration of the projectile at each instant must be a true measure of the force acting upon the projectile and upon the explosive contained in it. When the driving pressure on the base of the projectile is greatest, then is the acceleration of the projectile greatest, and then is the shock tending to explode it greatest. Nothing is gained by applying a small pressure at first and gradually increasing it; the maximum pressure on the base of the projectile, whether it occur before the projectile has had time to move or just as it reaches the muzzle of the gun, is what measures the danger of an explosion. Consequently, whatever form of gun is used for firing high explosive shell, the one requirement for safety is that the maximum pressure on the base of the projectile shall not be too great. It is just as safe to fire any high explosive shell from a powder gun as from an air gun, provided we limit the powder pressure to the pressure used in the air gun. This being understood, we have to consider the fact that the liability to explosion depends both upon the amount of explosive and upon its character. The column of explosive contained in the shell being driven forward with accelerated velocity, the greater the height of that column the greater the pressure upon its base, and if that pressure reaches a certain point an explosion will result. This is the reason why experiments with shell containing small amounts of high explosive have no value. Because a pound of nitro-

lowing table of estimates for 1896-7, taken from Brassey's Annual for 1896:

England	£21,823,000
France	10,637,096
Russia	6,440,666
United States	5,862,228
Germany	4,372,068
Italy	3,641,324

although in the table of effective fighting ships, built and building, the United States is left out, England, France, Russia, Italy and Germany only being included.

The progress in armor making referred to in my last public pamphlet (1894) has been continuous, and the United States (The Carnegie Steel Co., Ltd.) and Germany (Krupp) have produced armor fully 15 per cent., if not 20 per cent., better than the best *plain* steel Harveyed armor that Great Britain has placed upon her battle-ships; although one is handicapped in making thorough comparison so long as England continues to determine the value of her battle-ship armor by firing 6-inch soft Holtzer shells against 6-inch plates at velocities below 2000 ft. sec.

This comparison of superiority is based upon the Admiralty report of 1895-6, which states that—

> "During the year various experimental armor plates have been submitted by manufacturers for the purposes of test. None of these, however, have shown qualities equal to those possessed by the Harveyed steel armor mentioned in statement of last year."

Competition in the production of armor has become so active, the number of establishments for its manufacture so numerous, and the methods of its production and treatment, and its test, so complex, that it is not surprising there should be marked differences of opinion as to what kind and thickness of plate should be employed, and its distribution, and what caliber of ordnance should be used against it.

The most important tests that have been made in the past two years have taken place in the United States and Germany, and the results in these two countries have been so nearly identical that it became necessary for me to study very carefully the character of the projectiles employed. Since then, com-

There is absolutely nothing in the idea of special guns, air or other, being required for this; neither are any special forms of shell, cushioning devices and such, desirable or useful. The ordinary guns, with shell of ordinary form—only thin-walled so as to carry a large charge—and the ordinary powder charge, only reduced in weight, are all that we need or are likely to ever use, and, in my judgment, we could safely begin their use to-day if it were thought desirable to do so. But here is the rub. No one has entire confidence in the safety of such shell. The very idea that hundreds of shell, each charged with two hundred pounds of gun-cotton, are stored away in the magazines and must be brought up from below, loaded and fired in the heat of action, brings before the imagination such horrid pictures of the disastrous results of an accidental explosion in the gun, or anywhere inside the ship, that the mind refuses to be quieted by *ex cathedra* assurances that there is no danger. I have been present at numerous firing trials of high explosive shell, and I have been greatly impressed by the evident state of strain of the spectators, most of whom have been persons of long experience on the firing ground. These were all shell of comparatively small caliber, and I am convinced that the service use of large high explosive shell would produce a demoralizing effect upon both officers and men which would more than outweigh the possible increased destructive effect of such shell. Of course, this feeling of distrust would in time disappear if no accident occurred, and I only mention it as being a more potent reason for not putting high explosive shell on shipboard than is any difficulty in their actual manufacture and use.

As a natural sequence to the foregoing discussion of projectiles we now come to that of armor. In a paper which I had the honor to read here last year I argued for the continued use of armor, and pointed out its enormous advantages necessarily resulting from the fact that it effectually prevented the entrance into a ship of large capacity shell and of the multitude of projectiles delivered by the small rapid-fire guns. The first of these advantages is greatly reduced by the fact that the so-called armor-piercing shell are capable of being made truly so by the use of proper bursting charges; but even so, consider how much is gained if our armor will keep out all projectiles not of a caliber exceeding its thickness.

Very few large guns can be carried by even the largest ship,

and their rate of fire is slow. It is well worth while to pay the price for immunity from damage by the great number of small shell, even though we cannot escape the possibility of having our armor pierced by an occasional shell of large caliber.

Since the manufacture of armor was revolutionized by the discovery that face-hardening heavy steel plates was practicable, some further advance has been made by improvements in the methods of manufacture. It is found that a secondary forging of the plate, after carbonizing its face, but before tempering it, improves its resistance both to cracking and to perforation, and I think it can safely be said that we are now making the best armor in the world. Certainly all the tests abroad of which I have knowledge indicate the superiority of American to foreign made armor plate. Our nickel steel, carbonized, Harveyized, reforged plates are to-day equal in resistance to all steel plates, as made a few years ago, 60 per cent. thicker. That is, at present an 8-inch plate, when attacked by an 8-inch projectile of the best quality, requires for perforation a striking velocity of about 1900 foot-seconds, whereas the same projectile, with equal velocity, would have perforated a 13-inch steel plate. Last year I was of opinion that after our projectiles had been perfected this difference would nearly, if not quite, disappear, but further experience has convinced me to the contrary, and I now think that we cannot hope to reduce the lead of the face-hardened plate more than about 20 per cent., which would leave it finally about 30 per cent. better than the simple steel plate. This of course is a very great advance, and while partly due to other improvements, it is not at all an exaggeration to say that the successful introduction of the Harvey process has revolutionized armor manufacture.

With the best projectiles which we have to-day fired with the velocities given by smokeless powder, and striking normally at 2000 yards range, I estimate that complete protection will be given by our present armor plate if of the following thicknesses:

Against the 4-inch gun,	4-inch armor,
5- "	5- "
6- "	7- "
8- "	10- "
10- "	14- "
12- "	17- "

Of course the chance of normal impact is very small, and it may fairly be said that armor one caliber thick, under service conditions, will give complete protection from any gun below the 10-inch, 12-inch armor from the 10-inch gun, and 15-inch armor from the 12-inch gun. As for the 13-inch gun, we must trust principally to the small chance of being hit for protection against its projectiles.

It may be interesting to hear a word about the capped projectiles which have given remarkable results in recent tests. It has been proven by numerous trials of shell with and without caps, that their use tends to prevent the projectile from being broken up on hard-faced armor, and consequently greatly increases its perforating power. This appears to be because the cap, made of very soft metal, not only supports the point, but also acts as a lubricant for it. Once through the hard surface and the rest of the plate is comparatively easy to penetrate. We are in hopes, however, to learn before long how to make projectiles which will do the same work without caps as present ones do with them, and as I have said before, this will be a most important step in advance.

As to the distribution of armor on our ships, we have made some recent improvements, such as raising the belt armor slightly and adopting elliptical balanced turrets. I think, however, we need to go further in the first direction, and as far as turrets are concerned, we need above all to increase their floor space. One of the greatest bars to rapid working of the turret guns of most of the ships we now have is the cramped space in which the guns' crews have to work.

I have reserved for my continuing paper to-morrow the important subject of the steps which have been, and still need to be, taken to improve the *accuracy of gun fire*, and now, in conclusion, I want to say that I hope you will not undertsand me to claim that our ordnance material is perfect, or even that it is not in many ways actually defective. What I do claim is that no part of it is so defective as to be incapable of a high state of efficiency in the hands of zealous and intelligent men; that what it chiefly lacks is in small details, which can and should be improved on board each ship, and that the skill born of frequent practice will bring it nearer to perfection than any probable improvements which can be made by its designers.

heavy ordnance, the Navy Department having ordered 13-in. B. L. rifles for battle-ships, and the War Department having commenced a type gun of 16-in. caliber (both adhering to the forged hooped type), Great Britain still keeps the 12-in. as her limit and continues the radical departure to wire construction made by Dr. Anderson, when he became Director-General, and so successfully carried out by him.

France adheres to types containing too many parts, and Germany it satisfied to possess a large number of guns of comparatively low ballistic power.

As a great deal has been written in the various countries upon the comparative efficiency and battery power of the new United States battle-ships with those of England and France, the following tables, published by the Iron Age from data prepared by the Navy Department, will be of interest for reference.

In the preparation of this information a unit of time is used as a basis of comparison, and a muzzle velocity of 2000 foot seconds has been taken, together with the following weights of projectiles:

Caliber.	Lbs.	Striking energy in foot tons per gun.	Same, per gun in one minute of time.
13-inch,	1100	30,470	5,078
12-inch,	850	23,545	3,924
8-inch,	250	6,925	2,308
6-inch,	100	2,770	6,925
5-inch,	50	1,385	9,002
4-inch,	33	914	7,797
6-pdr.,	6	166	1,826
1-pdr.,	1	28	420

Battery and Battery Energy in Foot Tons per Minute.

	Type					
	Heavy guns.		Large R. F. guns.	Small R. F. guns.		Total energy.
	4 12-in.	8 8-in.	6 4-in.	20 6-pdrs.	6 1-pdrs.	
Iowa,	15,696	18,464	46,782	36,520	2,526	119,988
	4 13-in.	8 8-in.	4 6-in.			
Indiana,	20,312	18,464	27,700	36,520	2,526	105,525
	4 13-in.	4 8-in.	14 5-in.			
Kearsarge,	20,312	9,232	126,028	36,520	2,526	194,618
	5 13-in.		14 6-in.			
Proposed,	20,312	....	96,950	36,520	2,526	156,308

The United States Navy Department's decision as to what constitutes the most efficient battery for its battle-ships is expressed in the following armament decided upon for the three proposed new battle-ships:

Main battery: { 4 13-inch rifles, mounted in two turrets, fore and aft, and
14 6-inch rapid-fire in broadside. }

Secondary battery: { 16 6-pounders,
4 1-pounders, and
4 machine guns. }

In his reference to experimental guns in the 1896 report to the Secretary of War, the Chief of Ordnance speaks favorably of the Crozier wire-wound gun, which has been built at the army factory under the direction of one of its officers, Captain Crozier. The report states that the gun (fired 210 times) has made an admirable record and that wire-wound guns constructed on this system can be made with sufficient endurance and stability, but that in structural stiffness it is somewhat inferior to the service type. That the system, however, is looked upon with some favor is shown in the insertion in the annual estimates of the Department of an item to authorize, at its discretion, the manufacture of a limited number of wire guns.

The marked success of Dr. Anderson's wire guns, built at Woolwich, demonstrates their value and practically endorses my oft-repeated statement that I like the type and believe it can be as efficiently, economically and quickly supplied as the built-up form. It is simply a question of selection—of fashion.

No matter which type—hooped or wire—is adhered to, improved armor and projectiles must be met by greater energies which involve higher pressures, shorter guns (for utility) and stronger material. That this last is to be obtained in the United States is evident from the following requisites in a 3-inch test piece for *nickel*-steel tubes for cannon of 8-inch caliber and over:

Tensile strength, 90,000 pounds per square inch.
Elastic limit, 56,000 pounds per square inch.
Elongation, 20 per cent.
Contraction of area, 40 per cent.

Equally favorable progress has been made with projectiles, but as yet very few truly competitive results are at hand. The uncertainty of their relative value still causes a very large unknown quantity in the valuation of armor comparisons.

In conclusion, we may count, at least in the United States, as commercial commodities, armor having 10 per cent. greater resistance than the best of last year; heavy ordnance giving *service* velocities of 200 ft. sec. higher; and armor-piercing projectiles that, to be accepted, must perforate a thickness of nickel-steel carburized armor equal to their caliber. Truly an excellent record.

PROFESSIONAL NOTES.

A GENERAL DESCRIPTION OF THE WHITEHEAD TORPEDO,*

WITH A BRIEF SUMMARY OF ITS PREPARATION, ON BOARD SHIP, FOR A RUN,

By W. J. Sears, Lieutenant, U. S. Navy.

Weight of torpedo, ready for discharge	839 lbs.
Weight of wet gun-cotton (approximately)	110 lbs.
Length of torpedo	11 ft. 8 in.
Greatest diameter (45 centimeters)	17.7.
Speed, (about)	28 knots.
Range	1000 yds.

The Whitehead Torpedo is built chiefly of steel, and is nearly in the shape of a porpoise. It has a blunt, phosphor-bronze head, and is made in five sections, but dismounted and assembled in three parts. Its motive power is compressed air; it is propelled by two two-bladed screws, revolving about the same axis, in opposite directions, in order to neutralize their individual tendencies to produce lateral deviation. The after propeller is keyed to the main shaft, and the forward propeller to a sleeve or hollow shaft, free to move on the main shaft; by means of bevel gears on the main shaft, and on the forward end of the sleeve, suitably arranged, the propellers revolve in opposite directions.

The torpedo is maintained at constant depth by horizontal rudders, and on a straight course by vertical vanes set at an angle predetermined by experiment. The new models are great improvements on the earlier type in the matter of speed and certainty of work.

The War Head, of sheet phosphor-bronze, is charged with approximately 110 pounds of wet gun-cotton, and is closed at its base by a bronze bulkhead. In the bulkhead is a moisture tap, through which distilled water may be poured when necessary to make up possible loss of weight by evaporation.

Soldered in the forward end of the war head is the primer case of brass, in which is inserted the dry gun-cotton primer.

The wet gun-cotton is inserted in a series of disks, a sufficient number of them, counting from forward, being pierced through their centers to receive the primer.

The primer consists of a series of small cylinders of dry gun-cotton in a metal case. The forward cylinder is pierced to receive the detonating primer, containing fulminate of mercury and capped with a percussion cap.

* The article will be more readily understood by reference to the plates in the book issued by the Bureau of Ordnance, or to the torpedo itself.

THE EXERCISE HEAD, of steel, is ballasted for exercise by filling it with fresh water.

THE WAR NOSE screws into the forward end of the primer case. A traveling sleeve has a thread cut inside, throughout its length, and in this thread works a traveling nut. The nut is turned by a screw fan receiving its motion by its passage through the water. The nut is screwed back by the action of the fan until it rests against the firing pin. A shearing pin holds the latter in place, and as the nut continues to revolve, the sleeve moves out, carrying the fan with it, until the square shaft of the fan is pushed out clear of the nut. The fan then revolves freely. When the torpedo strikes the target the fan, nut and sleeve are driven in, shearing the shearing pin and driving the firing pin against the percussion cap.

IMMERSION CHAMBER.—This chamber contains the immersion regulators. It is just abaft the air flask and is riveted and soldered to it. The after end is closed by a bronze bulkhead.

The purpose of the mechanism in this chamber is to control the horizontal rudders, after launching, so as to bring the torpedo to a predetermined immersion and keep it there during its flight. This is accomplished as follows:

A small compartment in rear of the immersion chamber has free communication with the water outside through several apertures in its walls. The pressure of water, due to depth below the surface, acts against a piston; but the water is prevented from getting behind the piston by an annular diaphragm of thin rubber. The motion of this piston, due to different pressures at varying depths, is communicated to the horizontal rudders by means of rods in such a manner that when the torpedo is below its plane of immersion the increased pressure will elevate the rudders, and when it is above the decreased pressure will depress them.

When the torpedo is in its plane of immersion the piston is kept in mid-position by an equilibrium between the pressure of the water and the tension of a spiral compression spring.

PENDULUM.—A pendulum, which swings in a vertical plane passing through the axis of the torpedo, acts to maintain the torpedo in a horizontal plane. If the hydraulic piston is acting on the rudder to steer the torpedo up or down, when the torpedo has inclined 3 degrees above or below the horizontal plane, the pendulum swings towards the end of the torpedo that is lowest and counteracts the action of the piston on the rudder. The combined action of the piston and pendulum is transmitted by a system of lever and connecting rods to the steering engine, and thence to the rudder, to maintain the torpedo in the horizontal plane at the set depth.

THE AIR FLASK is a hollow, forged steel cylinder, slightly tapered at the ends, with dome-shaped heads screwed and soldered in each end. A strengthening band, left on the inside surface in boring, is tapped from the outside for three screws for attaching the guide stud. Over a hole in the after head is bolted and soldered the body of the charging and stop valves.

ENGINE ROOM.—Next abaft the immersion chamber comes the after body, containing two compartments; between them is a bulkhead. The joint is made tight by a rubber gasket. To this bulkhead the propelling machinery is secured. The engine room contains the main engine and oil cup, the valve group, the sinking and retarding gear, the steering engine, and the locking gear.

THE WHITEHEAD TORPEDO ENGINE consists of three cylinders, fixed radially about the propeller shaft, with their axes 120 degrees apart. Within the circular enclosure at the junction of the cylinders the main crank is free to revolve, and receives its impulse from the piston of each cylinder in succession. The compressed air is admitted behind the piston and evacuated in proper order by means of three slide valves, each working in a separate chest, on the forward face of each cylinder; but all regulated by a single cam, keyed to the main shaft.

THE DEPTH INDEX.—The head of a spindle is accessible from the outside of the shell, which, when turned by a socket wrench, compresses the spring acting against the hydrostatic piston, and thus increases the resulting immersion of the torpedo. Graduations on the index sleeve show the number of turns to give the socket wrench for the desired immersion. The depth index is then clamped by screwing down a clamping nut.

THE STEERING ENGINE is operated by air at the working pressure of the main engine, and transmits the action of the immersion mechanism to the rudder.

The combined action of the pendulum and hydrostatic piston is transmitted by a rod to the steering engine valve, which controls the action of the steering engine, and thence the position of the horizontal rudder.

The forward end of the valve rod screws in a union which connects it with the rod from the immersion mechanism.

Rigidly attached to the valve rod is a star wheel with six points, called the valve star.

Turning the valve star shortens or lengthens the valve rod, thus limiting the rudder movements.

It is usually set to give four divisions of down-rudder and three of up-rudder. The divisions are marked on the top blade of the tail of the torpedo.

The forward end of the steering rod acts against a spiral spring. When, at the end of the run, air is cut off from the steering engine this spring forces the steering rod forward, puts the rudder up, and brings the torpedo to the surface.

THE REDUCING VALVE is balanced between the pressure of a spring tending to raise it from its seat and the pressure of air on top of it tending to seat it. The object is to regulate the pressure of air admitted to the engine. A crank is used to screw down a plug which compresses the spring. The number of turns to be given this regulator plug for different speeds is given in a table.

THE STARTING LEVER admits air to the reducing valve, from whence it passes to the main engine. Before the torpedo is launched the lever lies flat along the upper surface of the shell, the end pointing forward. When the torpedo is launched the starting lever catches under a tripping latch, in the tube, and is thrown back.

THE DISTANCE GEAR provides means for automatically closing the reducing valve, and thus stopping the engines, after the torpedo has run a predetermined distance.

In general terms the action of the distance gear may be described as follows: A spindle, with a square head, is accessible from the outside of the torpedo, through a hole, and may be turned by a socket wrench. The spindle has a worm on its lower end, which engages the teeth of a wheel, with cogs around a portion of its circumference, called a distance sector. One turn of the spindle revolves the sector one tooth, and the number of turns for any distance is given in the table furnished.

The distance sector having been set for any distance, when the torpedo is set in motion the sector is revolved in the opposite direction to that in which it was turned in setting by suitable connections with the main shaft. When the sector has revolved back to the proper position it releases the tension on the spring of the reducing valve, which closes, and shuts off the air from the main engine.

Retarding Gear.—The object of this gear is to retard the admission of air to the engine from the instant of launching until the torpedo enters the water, thus preventing undue racing of the engine. A lever, called the retarding lever, is so arranged that when it is in a certain position (its after position) it will allow the reducing valve to open only slightly, thus throttling down the main engine. This lever is operated by a bell crank lever, to which is riveted a thin plate of steel, called the water tripper. When not in operation the water tripper lies flat along the surface of the torpedo. Before the torpedo is launched the water tripper is raised to a vertical position. When the torpedo is launched its rush through the water throws the water tripper down flat and releases the reducing valve to its full action.

Sinking Gear is provided for use in action for the purpose of sinking the torpedo at the end of an unsuccessful run. It is advisable, however, to remove one of the drain plugs in the after body (which will accomplish the same result) instead of using the sinking gear.

Locking Gear.—When the torpedo is launched the inertia of the pendulum causes it to lag to the rear, thus causing the torpedo to make a deep initial dive. To prevent this, locking gear is provided, which locks the steering engine valve rod until the pendulum will act independently of its inertia. The locking gear is attached to the after face of the immersion bulkhead, and the locking is accomplished by inserting a stiff rod through a hole in the top of the shell and forcing down a ratchet bar, which, acting through an arrangement of levers, locks the valve rod of the steering engine. A small pinion, by the engagement of its teeth with the teeth of the ratchet bar, holds the latter down against the tension of the spring.

This pinion receives a motion of rotation from the main engine, and thus gradually releases the ratchet bar, which in turn releases the valve rod of the steering engine.

The position in which the rudder is locked up, down, or horizontal, is regulated by a locking star. This position is determined by trial before entering the torpedo in the tube, the propellers being locked with the yoke, and the starting lever then thrown back for an instant.

The Tail of the torpedo consists of the part abaft the after body, comprising the gear box, the tail tube, and the frame of the tail. The latter consists of a forward and after cone, each carrying a pair of vertical flat blades and a pair of horizontal ones. The forward and after blades are joined stiffly together by rails. On the upper edge of the top rail is a guide which enters the guide slot in the tube in launching.

The gear box carries the bevel gears by which the motion of the main shaft is transmitted to the outer tubular shaft in a contrary direction.

The propellers, of steel, are two-bladed and are carried in tandem, the forward one, right handed, on the outer tubular shaft, and the after one, left handed, on the main shaft.

The rudder, of steel, is carried at the rear end of the tail, and is connected with the steering engine rod by a series of levers carried around the propellers on one of the vertical flat blades. Its motion is limited by a wedge.

The vertical vanes are set when the torpedo has its trial. They are pivoted at their forward ends, and can be swung on their pivots, to starboard or port, to give permanent rudder effect.

PREPARATION, ON BOARD SHIP, OF THE WHITEHEAD TORPEDO FOR A RUN.

Start air pumps, to charge accumulators.

Put yoke on propellers.

Close starting lever.

Enter head of torpedo in tube.

Put rope sling under after body, raise it from truck, at same time elevating breech of tube, as necessary, for torpedo to clear truck.

Place loading staff against end of propeller shaft and shove torpedo into tube, with guide stud just entering guide slot.

Remove charging valve plug.

Screw in valve end of charging pipe.

Open stop valve.

Open valves in air pipe between separator and torpedo.

Examine torpedo for leaks.

TRY STEERING ENGINE.—To do this admit air to steering engine by lifting the starting lever slightly. Insert a small rod through hole in shell of torpedo, place its end between the valve star and locking jaws, and move the steering valve rod as far forward, and then as far aft, as possible. This should give four divisions down rudder and three up rudder.

SET DISTANCE GEAR by means of socket wrench, inserted through a hole in the engine-room door, fitting over the square upper end of the adjusting spindle. The adjustment card gives the setting for 400 and 800 yards range.

See that the friction cam pin bears against the distance sector stud.

SET THE REGULATOR.—Insert the crank, with a square head, in the square socket of the head of the regulator plug. Screw the plug up until its upper face is flush with the top of the regulator body. The adjustment card gives the number of turns to be given to the plug to obtain maximum speed for a 400 or 800 yard run.

ADJUST THE LOCKING STAR.—The locking star is to maintain the rudder up, down, or horizontal while the rudder valve is locked. The adjustment is made with a rod, or screw-driver, inserted through a hole in the shell, on the side of the torpedo, the end pressing against one of the points of the star. Turning the star to the right (looking towards the head of the torpedo) moves the locking jaws aft and puts the rudder down; turning it to the left puts the rudder up.

ADJUST THE VALVE STAR.—The valve star is to set the valve of the steering engine, and thus control the throw of the rudder. This is done by turning the star, which practically shortens or lengthens the valve rod. The star is turned by inserting a rod or screw-driver through a hole in the shell, the end pressing against one of the points of the star. Turning towards the right (looking towards the head of the torpedo) shortens the valve rod and puts the rudder down; turning to the left puts the rudder up. A scale of divisions is marked on the top blade of the tail. When the valve is moved its full throw, the rudder movement is four divisions down and three up. The adjustment card gives the adjustment for the valve star.

SET THE RATCHET BAR.—Lock the steering engine valve rod by pushing down the ratchet bar with a stiff rod inserted through a hole in the

top of the shell of the torpedo. The number of teeth to engage for any distance is given on the adjustment card up to 13 teeth, the total number, which corresponds to a run of 100 yards.

Lift the starting lever slightly and test locking. Lower starting lever.

WHY LOCKED.—The steering engine valve rod is locked to prevent the rudder acting while the torpedo is gathering its headway. The inertia of the pendulum causes it to lag to the rear, which would put the rudder down and cause a deep initial dive. The valve rod is, therefore, locked until the pendulum will work independently of its inertia, when it is automatically released.

If it is desired to set the ratchet bar for any distance corresponding to the interval between any two teeth, insert a socket wrench through a hole in the bottom of the shell and turn the square-headed stop-screw. This is an adjustment seldom made.

VERTICAL VANES.—See that the vertical vanes are set according to the adjustment card.

DEPTH INDEX.—Put the socket wrench on the head of the spindle and screw it down until set to the depth (in feet) shown by graduation on the index sleeve. These are stamped on the sleeve for 5, 10, 15, and 20 feet. The depth index is put in place with the mark 5 corresponding with the fore and aft line. Starting from this point, adjust to any greater depth for the torpedo to run by turning the spindle of the depth index until the mark on the index sleeve comes to the fore and aft line; then set up the clamp nut.

OIL CUPS.—Fill valve group oil cup, gear box oil cup, engine-room oil cup, and oil after bearing. The oil in the valve group oil cup is for packing, and is forced out by pressure of air.

See all drain plugs in the after body closed.

Close valves in charging pipe; unscrew charging pipe, and screw in plug.

Lift firing lever and put in safety pin.

Lift water tripper.

Raise tripping latch and shove torpedo in tube.

Take off yoke and see propellers turned until notch on end of shaft is S.S.E. (This is to prevent engine being on center, as the cylinders cut off at ⅓ stroke.)

Work firing lever up and down, to see that stop pin is not jammed.

Close door of tube; load, prime, point, and fire.

THE UNITED STATES BATTLE-SHIPS ALABAMA AND CLASS.

[Reprinted from IRON AGE, Nov. 26, 1896.]

From a paper on the new battle-ships, read by Chief Constructor Philip Hichborn, U. S. N., at the recent meeting of the Society of Naval Architects and Marine Engineers, we take the following:

DRAFT.

In the paper presented to the society at its last meeting I mentioned some of the limitations and restrictions imposed upon those responsible for the designs of our war vessels, and it will be remembered that one of the principal difficulties enumerated was that due to the shallowness of

our harbors. The absolute limitation in draft imposed by this condition greatly complicates the design when so many other elements have to be taken into consideration; but the success attained in this direction is believed to be quite satisfactory, since the draft of the new battle-ships is only 23 feet 6 inches at their normal displacement, with all outfit, and two-thirds supply of stores, ammunition, etc., on board and 800 tons of coal in the bunkers.

SPEED.

As in all recent designs of battle-ships for the United States Navy, a moderate speed only has been attempted, as it has generally been held in this country that the high speeds aimed at by some foreign navies were not desirable in battle-ships when obtained by sacrificing other and more essential qualities. For this reason the designed speed of our recent battle-ships is more than a knot less than that required for some new foreign designs; but this speed is still much greater than will ever be employed in fleet tactics, or the actual operations of war; in fact, the highest speed heretofore adopted in fleet tactics with battle-ships has rarely exceeded 12 knots. Moreover, the speed developed by our vessels during their contract trials is maintained steadily for four hours and is not a mere measured mile record, thus affording a very accurate measure of the endurance which might be expected in actual service—a test which the measured mile record of certain foreign services does not afford.

FRAMING, SPECIAL FEATURES, ETC.

The framing of these new battle-ships is slightly different from that hitherto in vogue in vessels of this class in our service. The main frames are continuous from the keel to the armor shelf, and again from the armor shelf to the upper deck. The longitudinals are of course continuous, their lower edges being scored over the main frame angles and the lower angles of longitudinals being worked intercostally. The upper angles of longitudinals are, however, continuous, while the reverse bars are worked intercostally. Between the frame angles and reverse bars are worked bracket plates of uniform width, flanged at one end so as to connect with the longitudinal, and also flanged at the other end to give local stiffness. In this manner great rigidity is given to the floors of the vessel and there is less liability to damage in grounding or docking; at the same time this flanged floor plate provides greater strength of structure with the expenditure of less weight.

Docking keels are also provided, the extremities of these keels terminating at the athwartship planes passing through centers of 13-inch turrets, the bottom surface of the docking keels and the middle line keel of the ship being in the same horizontal plane.

ARRANGEMENT OF BOILERS AND COAL BUNKERS.

In the arrangement of coal bunkers special care has been taken to provide easy stowage and accessibility for firing, at the same time affording good coal protection for the boilers. There are athwartship bunkers at each end of the boiler space, and large longitudinal bunkers at the sides, all of these bunkers opening directly into the fire-rooms. A distinct departure from former practice in our service has been made in the arrangement of boilers, which, instead of being placed fore and aft, are placed athwartships, with the furnace doors and fire-rooms on the outboard side. This affords excellent facilities for firing and also provides easy communication between the fire-rooms.

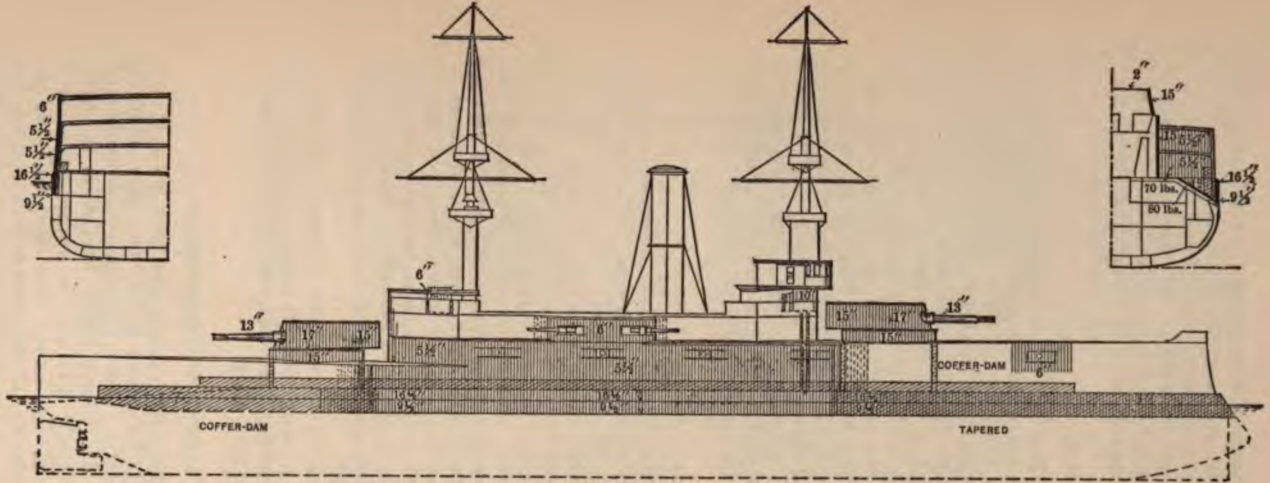

Fig. 1.—Side Elevation, Showing Armor and Armament.

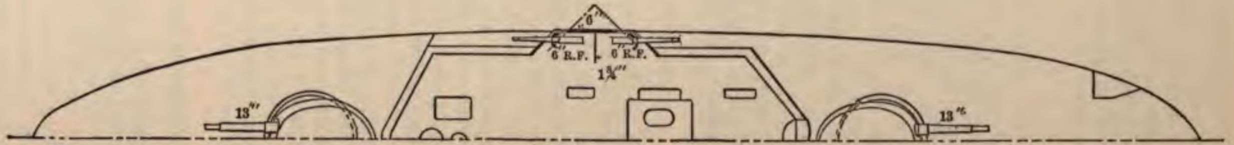

Fig. 2.—Half Plan.

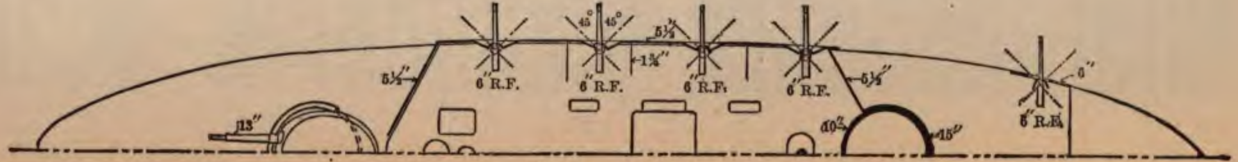

Fig. 3.—Half Plan.

HULL PROTECTION.

The hull is protected against injury at the water-line region by heavy tapered armor of a maximum thickness of 16½ inches, and extending from 3 feet 6 inches above to 4 feet below the normal load water-line. The maximum thickness is maintained for the entire length of the engine and boiler spaces. Figs. 1 to 4. From the forward athwartship coal bunker bulkhead the thickness is gradually reduced until it reaches 4 inches, which thickness is maintained to the bow. At the top of the belt, for the length of engine and boiler spaces, a flat protective deck 2¾ inches in thickness, worked in three layers, extends from side to side of vessel, being tap riveted to upper edge of side armor. Forward of the machinery space, however, the protective deck is turned down or inclined to the armor shelf level. Thus, any projectile passing through the vertical armor would, even if it were not broken up or deflected in its passage, have to encounter a sloping deck 3 inches in thickness. Abaft the heavy armor belt the protective deck is worked in a similar manner to that described for the forward end of the ship, except that the slope plating is increased to 4 inches in thickness in order to afford greater protection to the steering gear. Where the protective deck is inclined at the sides, as above described, coffer dams 3 feet in width and extending to the top of armor belt are provided, and are to be packed with corn pith cellulose, compressed to a density of 6 pounds per cubic foot.

To provide as far as possible against the serious damage to the boilers and engines due to a raking fire from forward or aft, the opening between the flat deck and the sloping sides is, at each end of the machinery space, closed by diagonal armor bulkheads 12 inches in thickness.

From the top of the thick belt, extending to the main deck, the hull is further protected by a belt of light armor 5½ inches in thickness; this armor extends from barbette to barbette, ending in diagonal bulkheads

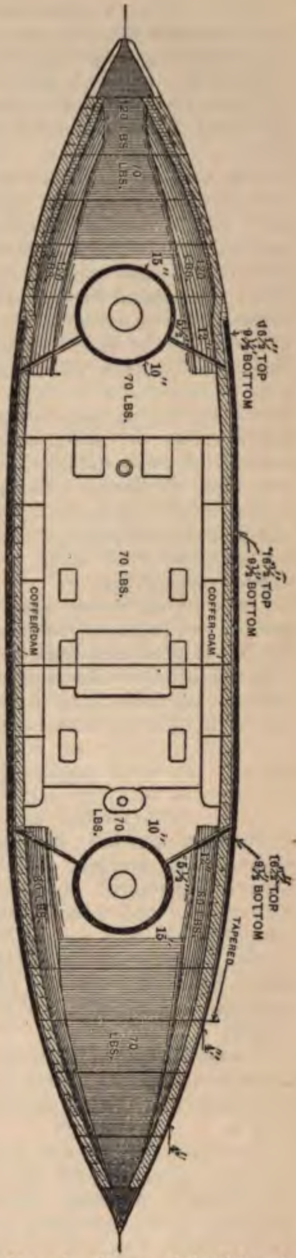

Fig. 4.—Plan Showing Armor.

in line with the 12-inch bulkheads below. Within the limits of this belt the broadside torpedo tubes are placed. Inboard of this 5½-inch armor, and extending well forward and aft, as shown on plans, are worked coffer dams 3 feet in width and 3 feet high, the top of the coffer dams being 6½ feet above the load water-line. These coffer dams are also filled with corn pith cellulose packed to the same density as those on the protective deck.

The side of ship between main and upper decks, and from forward barbette to a point just forward of the after turret, is protected by 5½-inch armor, with diagonal armor terminations, the forward one being worked immediately over the diagonal bulkhead of the deck beneath. Within this light redoubt are placed eight of the 6-inch rapid-fire guns. Thus the central portion of the vessel is completely inclosed by a continuous wall of armor extending from 4 feet below the load water-line to the level of the upper deck, a distance of about 23 feet, and the walls of this redoubt are in no place less than 5½ inches in thickness.

In addition to this very complete protection of the greater part of the 6-inch rapid-fire gun battery against the entry of smaller projectiles, the guns' crews are still further protected by 1½-inch splinter bulkheads worked between each pair of 6-inch guns, thus minimizing the effect of exploding shells, even though they should enter the armored redoubt.

The other 6-inch gun positions, on the gun deck forward and on the upper deck amidships, are protected by armor 6 inches in thickness, that on the upper deck being turned in at the ends so as to afford protection against raking fire.

The conning tower, situated as shown on the drawings, is protected by armor 10 inches in thickness, being connected with a central station below the protected deck by a tube, the walls of which are 7 inches thick.

In addition to the conning tower forward, these vessels are provided with an armored signal tower at the after end of the superstructure deck, the walls of this tower being 6 inches in thickness.

THE BATTERY AND ITS PROTECTION.

In the character and arrangement of the battery of the Alabama class decided changes have been made from the designs of former ships of this type in our service. In the first place, the 8-inch battery has been entirely abandoned, and the calibers of the heavier guns reduced to two, viz., 13-inch and 6-inch guns. This departure was made upon the recommendation of a special board which was ordered to report upon the whole question of battery arrangement, etc., the ground taken by the board being that the use of an intermediate caliber, such as the 8-inch gun, was unnecessary, and complicated the arrangements for ammunition supply.

Of course many arguments may be advanced for as well as against the findings of the board, but the arrangement adopted in the Alabama class is in line with recent foreign practice and will undoubtedly give good results.

The main battery will consist of four 13-inch guns, mounted in pairs in turrets forward and aft on the midship line, and protected by armor 15 inches in thickness, with port plates 17 inches thick. The ammunition hoists and revolving gear of turrets are protected by barbettes 15 inches thick, except over the arc within the diagonal armor, where the barbette is reduced to a thickness of 10 inches, to save weight.

The turrets are oval in shape, with the front plates slightly inclined and the rear plates vertical, in order to give ample room for the handling of the guns and their loading appliances. The center of gravity of the revolving parts is in the axis of rotation, so that the turret is balanced and can thus be turned by its engine without serious retardation, even when the ship has a heavy list. The forward turret is at the level of the forecastle deck, the axis of the guns being 26 feet 6 inches above the normal load water-line; the after turret is on the main deck, the axis of the guns being 19 feet above the normal load water-line. Each pair of guns sweeps an arc of 135 degrees from the midship line.

Three sighting hoods are provided for each turret, the one in the middle being for the turret turner, whose sole duty is to keep the guns pointed at the target, as far as their lateral direction is concerned. The hoods on each side are for the gun pointers.

Between these 13-inch gun emplacements, and within the armored casemate previously described, are eight 6-inch rapid fire guns in broadside. These guns are capable of a total arc of train of 90 degrees and are protected by 3-inch shields supported on the carriage and the 5½-inch armor of the casemate. Each gun is separated from its neighbor by 1½-inch steel splinter bulkheads. Four more 6-inch rapid-fire guns—two on each side—are mounted on the upper deck, above this casemate; they are protected by 6 inches of armor, and are capable of firing fore and aft. On the gun deck forward is another pair of 6-inch guns protected by an armor plate 6 inches thick.

The auxiliary battery consists of seventeen 6-pounders and six 1-pounder guns, mounted where practicable to obtain good command and yet be clear of the blast from, and interference with, the rest of the battery. Four broadside torpedo tubes, situated as shown on plans and protected by 5½ inches of armor, complete the armament of these vessels.

The following table gives the weight of fire of one discharge (neglecting the auxiliary battery) from all the guns available on the bearings given, and affords an interesting comparison of the relative weights of fire of these vessels as compared with the Kentucky, Iowa and Indiana classes. There is also given a table showing the complete batteries for the same vessels.

Table of Weight of Battery Fire for First-class Battle-ships of the United States Navy.

	Ahead or astern. Pounds.	Bow to quarter. Pounds.
Alabama class	2400	5100
Kentucky class	2700	5750
Iowa	2766	4499
Indiana	3400	5600

HULL.

Length on load water-line	368 feet.
Length over all	373 feet 9 inches.
Breadth molded	72 feet.
Breadth extreme	72 feet 2½ inches.
Freeboard forward	20 feet.
Freeboard aft	13 feet 3 inches.
Freeboard amidships	19 feet 10 inches.
Mean draft (with 800 tons coal and two-thirds stores and two-thirds ammunition)	23 feet 6 inches.

Corresponding displacement	11,520 tons
Speed per hour, in knots	16.
I. H. P.	10,000.
Mean draft (with all stores, provisions and ammun'n and 1200 tons of coal on board)	24 feet 7 inches.
Corresponding displacement	12,140 tons.

ARMAMENT.

Main battery	4 13-inch B. L. R. 14 6-inch R. F. G.
Secondary battery	17 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings. 1 field gun.

ARMOR.

Material: Harveyed nickel steel.

Water-line belt, thickness amidships	Top ....16½ inches. Bottom ..... 9½ inches.
Height of upper edge above normal load line	3 feet 6 inches.
Total depth of belt	7 feet 6 inches.
Side armor above main belt, thickness	5½ inches
Superstructure armor, thickness	5½ inches
Turret armor (13-inch guns), thickness	17 and 15 inches.
Barbette armor, thickness	15 and 10 inches.
Protective deck armor, thickness	2¾ to 4 inches.
Conning tower armor, thickness	10 inches.

MACHINERY.

The main propelling engines will be of the vertical, inverted cylinder, direct-acting, triple-expansion type, and will be placed in two water-tight compartments separated by a middle-line bulkhead.

Collective I. H. P. of propelling air pump and circulating pump engines	10,000.
Number of revolutions for above I. H. P.	120.
Diameter high-pressure cylinder	33½ inches.
Diameter intermediate cylinder	51 inches.
Diameter low pressure cylinder	78 inches.
Length of stroke	48 inches.
Cooling surface of main condensers	7,000 square feet.
Cooling surface auxiliary condenser	800 square feet.

There will be eight single ended steel boilers of the horizontal return fire tube type, placed in four water-tight compartments.

Dimensions of boilers: Length	9 feet 11¼ inches.
Dimensions of boilers: Diameter	15 feet 6½ inches.
Working pressure (pounds per square inch)	180
Total heating surface of all boilers	21,200 square feet.
Total grate surface	685 square feet.
Number of furnace flues	4
Diameter of flues	39 inches.

CRUISERS WITH RAMS.

[ENGINEERING.]

Although there is much difference of opinion as to the tactical advantages of the ram in warfare, there is none as to the possibility of conditions arising where it would be of effective use, and it is interesting to note that in the design of a class of cruisers now being completed in the Dockyards, special attention has been devoted to the strengthening of the ship forward, so that they may use their ram without the least fear of serious damage resulting to their structure. These vessels are known as fleet cruisers, and one of them—the Furious—is to be launched to-day (Dec. 3) at Devonport; a second—the Gladiator—we believe will be floated on Dec. 8, at Portsmouth. The Vindictive is building at Chatham, and the fourth—the Arrogant—is being completed at Devonport. It is important, however, to note that they are as effectively armed as ordinary cruisers, and thus one serious objection to special ram ships is removed. Hitherto armament has been made a secondary consideration in such vessels. After the demonstration of the effective use of the ram in the American war and at Lissa, we, in common with some other nations, built light ships with powerful rams, and with one, or at most a couple of guns, mounted in a forward turret. The old Hotspur and Rupert represent this stage in the evolution of the class. In the succeeding ships, the Hero and Conqueror, heavier guns, and a turret with weapons for stern fire, were fitted, with larger engine power. Later, as a result of the agitation headed by Admiral Sir George Sartorius, the Polyphemus was built, her only function being to ram, and thus her armament consisted of light guns to ward off torpedo attack. The absence of guns was regarded by some as a satisfactory feature, since their smoke might have affected the steering towards the enemy to be rammed. The officer fighting the ship, however, could have silenced his guns and freed his course of smoke at the crucial moment; but even if the objection were well founded, it is removed by the use now of smokeless powder; and a cruiser, primarily designed for ramming, should also have heavy bow fire.

The cases of ramming have not yielded much instruction except in one point, and that seems to be that the ship ramming is as likely to be injured, although perhaps not so disastrously, as the one rammed. This is especially so when both are manœuvred, a circumstance proved in the case of the Camperdown-Victoria collision in June, 1893; while at Lissa there is the case of the Kaiser being more injured than the Portogalla which she rammed, so that Sir William White, the Director of Naval Construction, in the new ram cruisers has done well in meeting this objection, for, as shown in the sinking of the old Vanguard, of the Grosser Kurfurst, of the Cumberland in the American war, and of the Huascar in the Chili-Peruvian war, ramming can be effective, and it is necessary to specially provide for it. In the Furious and the other vessels of the class, the stem is massive and well braced to the interior structure, the framing is heavy, the shell plating is 1 in. thick, and over this there is nickel steel armor plating 2½ in. thick, extending for a very considerable distance aft, although with decreasing depth. At the stem it is the full depth of the ship, but the top edge curves downwards and the bottom edge upwards, so that the belt continues at the water line for a distance of quite 50 ft. from the ram.

Another necessity is quick manœuvring. The most effective cases of ramming in warfare, that of the Huascar and Cumberland, for instance,

were when the enemy was at anchor. That, however, is a contingency not to be depended upon, and two opposing ships may have the same desire to ram. Effective speed and manœuvring will greatly assist calm judgment in such a case, and everything that wide experience can do has been done in the Furious class. There are two rudders, one forward, the other abaft, the twin propellers. The deadwood is cut away; in other words, the flat plate keel slopes upward, giving the propellers a clear sea in which to work. The after rudder is of the usual balanced type and worked in the ordinary way, the bottom of the rudder, like the propeller brackets, being supported on framing. The small auxiliary rudder forward is of the same type. It is worked by worm gearing from the same head as the main rudder. The speed, an important element also, is to be 19 knots, and the dimensions of the ship have been minimized to improve the manœuvring qualities. They are the shortest cruisers for their size in what may be termed the modern Navy, for although of 5800 tons displacement they are only 320 ft. long by 57 ft. 6 in. beam, and their mean draft is 21 ft.

A strong feature, as we have already suggested, is the weight of bow fire. On the forecastle there is to be mounted in a central position a 6-in. quick-firing gun, protected by a 3-in. shield, while a little further aft on either side is a gun of the same calibre, similarly protected. These guns fire in line with the keel and 30 deg. abaft the beam, and as the forecastle deck is formed with what is known in the merchant service as a turtle back, the possible depression of these guns will be greater than with ordinary ships. An indent is made so that the top of the anchors when housed may be flush with the deck. The stern fire consists of a 6-in. gun mounted on the upper deck. There is no poop, but an extensive bridge aft as well as forward with a gangway between, made convenient also for working the boats. In addition to this after 6-in. gun, there is on either side a 12-pounder. On each broadside are three 4.7-in. quick-firing guns, firing through 180 deg. There are also 12 smaller quick-firing guns, so that the cruisers are well armed.

For protection there is an armored deck right fore and aft, and the engines are completely under it. Along either side are arranged the coal bunkers, while over the protective deck again there are coal bunkers, and these are divided longitudinally by three bulkheads, as well as by the usual athwartship divisions. The normal coal capacity is 500 tons; but this may be considerably augmented, so that in this, as in all other recent cruisers, a wide radius of action has been provided for.

The boilers are of the Belleville type, the engines of the triple expansion design.

LIQUID FUEL.

Experiments have been in progress for more than a year, chiefly in the Hudson river, with torpedo boat No. 2, belonging to the Maine. They have resulted so happily that the engineers have made a report favoring the adoption of the fuel under given conditions upon certain minor craft, such as tug boats and torpedo boats. If the results foreshadowed in this report shall be realized a revolution is at hand in the fuel for war ships and all ocean going craft.

The Experimental Board of Naval Engineers consists of Chief Engineer H. S. Ross, of the Massachusetts, and Chief Engineers Lewis J. Allen and George Currie, Jr. They were designated about a year ago, by Chief Engineer G. W. Melville, Engineer in Chief of the Bureau of

Steam Engineering, U. S. N., to experiment with an invention submitted by J. S. Zerbe, chief engineer of the Consolidated Gas Company.

A SEVERE TEST.

They have submitted the apparatus to the severest possible test. Their operations have been known to the naval officers of all the nations, and several foreign countries have applied to have a share in them, but this was refused, as it was deemed wise to preserve the utmost secrecy.

The tests of a new fuel for steam vessels are cheapness, ease of operation, economy of room and general efficiency. The Board reports favorably upon the Zerbe apparatus in respect of all these points. The evaporation was found to be seventeen, eighteen, nineteen and twenty pounds of water, at various pressure, to one pound of oil, or more than double that of the best coal with the same boiler. The pressure of steam was constant, which means economy of fuel and equalization of pressure upon the machinery. There were no ashes nor dirt to injure the fine mechanism, and no stokers were required. The fuel can be put on board at sea.

Other important advantages are claimed for the new device. It is said to be as safe as coal and to occupy so much less room that a vessel having a steaming radius of 1000 miles with coal would be able to steam 2000 miles with the same bulk of petroleum. The waste space now devoted to water ballast forms, it is said, a perfect petroleum bunker, to be reoccupied by water as the oil is consumed. For the commercial marine this would mean a cubic foot available for freight for every cubic foot of coal bunking space saved.

NEW FIRE BOX.

The equipment of the fire box constitutes the most important departure in the new invention. The grate bars of the ordinary furnace are utilized for the purpose of forming thereon a brick bed. This bed is composed of bricks which have grooves partially across one face. They are laid on the grate bars at an angle of forty-five degrees, thereby forming air ducts over the entire surface of the bed and also making a corrugated surface.

Instead of injecting the oil through round injectors, a fan shaped spray is distributed over this foraminous bed, which bursts into flame on striking the bed, heating up the latter to incandescence. The air passing through the grooves and uniting with the carbonic gases generated by the contact of the oil spray with the heated brick makes a perfect oxy-hydrogen flame.

For injecting the oil and breaking it up compressed air is utilized.

EXPERIMENT UNDER DIFFICULTIES.

The torpedo boat upon which the experiment was conducted was originally designed for coal, hence there was no available space within the hull in which to locate oil tanks. It was necessary to place tanks fore and aft within the cockpits. A specially designed duplex pump was located in the fire room, one side of which pumped sea water into the bottom of the oil tanks, and the other side of the pump was connected with the top of these tanks for the purpose of pumping oil from them to the burners in the furnace. By this means the tanks are always filled with liquid, preventing the swashing motion so dangerous and

offering the further advantage of never changing the submergence and trim of the vessel.

The Maine's torpedo boat No. 2 had a speed limit of 13½ knots with coal. It attained to more than 14 knots with oil, having aboard a crew of seventeen men and six tons of coal.

It is said that the Holland submarine boat will probably be equipped with the new invention for further experiment.

CANET'S DUPLEX MOUNTING FOR QUICK-FIRING GUNS.

[ENGINEERING.]

Mr. G. Canet, of the Forges et Chantiers de la Mediterranée, of La Seyne, Havre, and Paris, has recently devised a new method of mounting guns in pairs for working on one platform. The mounting is composed of a twin sleeve surrounding the rear part of the guns, and carrying in front the trunnions that are supported by the side brackets of the frame. On the upper part of the sleeve are the brake cylinders, and the compressed air reservoir by which the guns are brought back automatically; on the lower part of the sleeve is the locking slide of the elevating gear. The brakes are of the Canet system, with the central rod of variable section. The brake plunger has on each side a rod of different diameter. The smaller extends backwards, and is connected to the cross-piece fixed to the breech of each gun; the larger enters the cylinder during the period of recoil and drives out a part of the liquid it contains; this liquid acts through a pipe and valve on the piston of the central cylinder, in which the air is compressed in front of the piston. At the end of the recoil the valve closes, but a second pipe open to both sides of the valve, and controlled by a lever outside, allows the liquid previously driven out, to flow back into the brake cylinder, under the influence of the air compressed in the receiver, thus throwing the gun forward into firing position. According to whether the bye-pass pipe is opened or closed at the moment of firing, the guns are run out at once, or are held back. The central variable rods are fixed to the projections on the upper part of the sleeve. They move, during recoil, inside the piston rods, thus constantly changing the area of the openings of the brake. The sighting devices are attached to the sleeve on the mounting. The guns are trained for elevation by a toothed sector, fixed under the sleeve; into this gears a pinion worked through a countershaft by means of a hand controlling wheel and a pitched chain. The turning platform rests on a live ring of hard steel balls, and it can be trained either by hand or by an electric motor. The mechanism of this part of the mounting comprises a fixed toothed ring, two pinions gearing into it, and a third pinion on the shaft of which is mounted, by means of a special compensating device, a helicoidal gear. An endless screw drives this gear, and is itself actuated, either by a pair of bevel wheels connected with the electric motor, or by a pitched chain transmission worked by hand. By means of a clutch the hand or power gear can be thrown at once into operation. A supply of ammunition is furnished to the gun by a central endless chain moving with the platform on the well-known Canet system, and delivering at the side of the mounting. Provision can be made for a store of projectiles being placed close to the platform, in which case only the cartridges would have to be delivered from below.

This method of mounting, which is applicable to all calibres of quick-firing guns, possesses the following very considerable advantages: The weight and bulk of the mounting are reduced to a large extent, and consequently the weight and cost of the shield and local armor are also reduced. This reduction in weight means that the power of the ship for offensive purposes can be correspondingly increased. The axes of the two guns being as near as possible, the strain arising from firing one gun is reduced to a minimum, consequently the wear of the mechanism from lateral training is also reduced. The men training the guns have all the necessary mechanism conveniently arranged, so that the guns can be fired more rapidly and with a reduced *personnel*. Both guns are elevated simultaneously; from this it follows that after a round has been fired successfully, a second round can follow immediately, or if any correction is necessary it can be very rapidly executed. By this means the efficiency of the armament is increased. The arrangement has been developed from the twin mountings previously installed by M. Canet on the Prat, the Jauréguiberry, etc. But in these mountings the guns were trained independently, and were of necessity placed farther apart from each other.

EXPERIMENTAL TEN-INCH WIRE WOUND BROWN SEGMENTAL GUN FOR U. S. ARMY.

[SCIENTIFIC AMERICAN.]

The Ordnance Department U. S. Navy has taken in hand the construction for experimental purposes of a 10-in. wire wound Brown segmental gun.

The advantages claimed for the core of the gun in this system are as follows:

1.—In consequence of the small weight of each of the component parts of the gun, crucible steel can be used economically. 2.—The small size of the segments, and the ingot from which they are rolled, admit of being carefully cast and uniformly forged, so as to insure uniformity of metal and of being thoroughly annealed. 3.—As they can be readily rolled into shape, the method of construction is exceedingly economical. 4.—They can be thoroughly and conveniently inspected. 5.—The size and thinness of each segment insures a thorough and uniform tempering and annealing, if temper be considered desirable. 6.—The size of the segments admits of readily setting up conditions of special elasticity by cold work.

This latter feature is by far the most important one in this system of construction, as it renders it possible to use a character of steel far beyond anything heretofore employed in the core of a gun. The core of such a gun whose bars or shoes have been hardened, annealed and cold drawn could readily be wound so as to produce a compression between the segments of 112,000 pounds to the square inch without exceeding the elastic limit of the weapon.

In the manufacture of the 10-inch Brown gun the production of the segmental core is the most novel feature. The segments, which are made from open hearth steel, are cold drawn and are tapered and beveled in the working. This is done so accurately that no machining is necessary. They are assembled vertically, with the large end down, in much

the same way as a cooper assembles a barrel, and are temporarily held together with three-part clamps placed one foot apart. The core is then put in a lathe, the two ends are machined, and the breech and muzzle nuts are shrunk on. The lathe is then set at the taper of the finished gun, and the outside of the core is turned down from nothing at the breech nut to a depth equal to the thickness of the wire, at twelve inches from said nut. Here the operation is again repeated for another twelve inches, and so on until the muzzle nut is reached. The steel wire is $\frac{1}{7}$ of an inch square in section, with a sectional area of $\frac{1}{49}$ of an inch. The end of the wire is keyed into the gun at the breech nut and it is wound on at the required tension by means of the automatic winding machine. When the wire reaches the shoulder it is tightly wedged in against it, turned over, and keyed into the gun. The next layer is started at the second shoulder, 24 inches from the breech nut, and wound back to the breech. The third starts at the breech and runs to the third shoulder, the successive layers running in contrary directions until the necessary amount of wire is laid on. The gun is then bored out, heated internally by gas, and shrunk onto a thin steel liner. The chase jacket is shrunk on in two foot sections. The trunnion jacket is interlocked at the breech end by shrinking on, and fits with a slip joint over the chase. The breech closure is screwed into the projecting end of the jacket, and the trunnion ring is screwed on over the front end of the same jacket, so that the recoil of the gun is taken up directly by the jacket and transferred by the trunnions to the gun carriage. The longitudinal stress is taken in part by the longitudinal segments. In addition to this, the method of cross wrapping the wire in itself imparts considerable longitudinal strength to the gun.

The winding of the wire at a constant tension is done by an ingenious machine. It consists of a stout frame, bolted to the lathe carriage, which is provided with a large overhead spool to carry the wire, and a small car which runs on a track at right angles to the axis of the gun. Upon the car are journaled two sets of adjustable steel rollers, between which the wire passes and by means of which the necessary tension is given to the wire as it passes to the gun. The pressure between the rollers is regulated by means of coil springs, controlled by thumb-screws. The two sets of rollers are geared to two brake wheels above and below the car. The upper brake wheel has a fixed brake. The lower brake is automatic in its action and is controlled by the position of the car. From the rear of the car a set of wires passes over a pulley which is suspended between the vertical frames, and down to a bracket which carries a certain amount of dead weight. The winding is started with the weight resting on the floor. The hand wheel on the brake is then turned until the weight is raised, when the tension in the wire equals the weight. As the car travels toward the gun, the brake wheel is released by an automatic gear and the car soon finds a position of equilibrium. The brakes are kept cool by water pipes.

The wire used in the construction of the 10-inch gun will have a total length of 75 miles.

The high quality of steel which it is possible to use in the segmental wire gun is evident from the official tests of the metal put into the 5 inch gun of this pattern. The segments showed an elastic limit 126,000 pounds per square inch and an ultimate strength of 176,000 pounds per square inch; the wire shows an elastic limit of 230,000 pounds and an ultimate strength of 262,000 pounds per square inch.

GROWTH OF THE U. S. NAVY.

The following tables, taken from the report of the Hon. Secretary of the Navy, represent the development of our new Navy during the past four years:

TABLE I.

VESSELS AUTHORIZED BY CONGRESS SINCE MARCH 4, 1893.

Name.	Displacement.	Speed.	Main battery.	Where built or building.	Contract date of completion.
	Tons.	*Knots*			
Kearsarge	11,520	16	4 13" B. L. R.; 4 8" B. L. R.; 14 5" R. F. G.	Newport News Shipbuilding and Dry Dock Co., Newport News, Va.	January 2, 1899.
Kentucky	11,520	16	. . do. . .	. . . do. . . .	do.
Illinois	11,520	16	4 13" B. L. R.; 14 6" R. F. G.	. . . do. . . .	Sept. 26, 1899.
Alabama	11,520	16	. . do. . .	Wm. Cramp & Sons, Philadelphia, Pa.	Sept. 24, 1899.
Wisconsin	11,520	16	. . do. . .	Union Iron Works, San Francisco.	Sept. 19, 1899.
Total . . (5)	57,600				
Gunboats.					
Annapolis	1,000	12	6 4" R. F. G.	Lewis Nixon, Elizabethport, N. J.	Feb. 20, 1897.
Vicksburg	1,000	12	. . do. . .	Bath Iron Works, Bath, Me.	Feb. 15, 1897.
Newport	1,000	12	. . do. . .	. . . do. . . .	do.
Princeton	1,000	12	. . do. . .	J. H. Dialogue & Son, Camden, N. J.	Feb. 20, 1897.
Wheeling	1,000	12	. . do. . .	Union Iron Works, San Francisco.	Feb. 26, 1897.
Marietta	1,000	12	. . do. . .	. . . do. . . .	do.
Total . . (6)	6,000				
Torpedo boats.					
No. 3	142	24.5	3 torpedo tubes; 3 1-pdr. R. F.	Columbian Iron Works, Baltimore, Md.	Aug. 3, 1896.
No. 4	142	24.5	. . do. . .	. . . do. . . .	do.
No. 5	142	24.5	. . do. . .	. . . do. . . .	do.
No. 6	*182	27.5	3 torpedo tubes; 4 1-pdr. R. F.	Herreshoff M'f'g Co., Bristol, R. I.	Aug. 19, 1896.
No. 7	*182	27.5	. . do. . .	. . . do. . . .	Nov. 19, 1896.
No. 8	182	26	. . do. . .	Moran Bros. & Co., Seattle, Wash.	Jan. 19, 1897.
No. 9	146	30	. . do. . .	Bath Iron Works, Bath, Me.	April 6, 1898.
No. 10	146	30	. . do. . .	. . . do. . . .	do.
No. 11	273	30	. . . . . .	Union Iron Works, San Francisco.	April 5, 1898.
No. 12	117	22.5	3 torpedo tubes; 3 1-pdr. R. F.	Wolff & Zwicker Iron Works, Portland, Oreg.	Oct. 6, 1897.
No. 13	117	22.5	. . do. . .	. . . do. . . .	do.
No. 14	†103	22.5	3 torpedo tubes; 3 1-pdr. R. F.	Herreshoff M'f'g Co., Bristol, R. I.	Oct. 6, 1897.
No. 15	†47	20	2 torpedo tubes; 1 1-pdr. R. F.	. . . do. . . .	do.
No. 16	†47	20	. . do. . .	. . . do. . . .	do.
No. 17	65	20	. . do. . .	Chas. Hillman Co., Philadelphia, Pa.	Oct. 7, 1897.
No. 18	65	20	. . do. . .	Columbian Iron Works, Baltimore, Md.	do.
Total . . (16)	2,098				
Submarine torpedo boat.	168	8	. . . . . .	. . . do. . . .	March 13, 1897.
Grand total	65,866				

* Approximate. † Trial displacement.

rangements. A central hoist revolving with the turntable admits of powder charges being brought up to the gun in any position of the gun, and a store of projectiles in the gun-house enables the guns (or either of them independently of the other) to be loaded and fired without the loss of time necessitated by having to return to a fixed loading position. Certain details of the method of raising the powder charge are, however, new in the Prince George. A high speed hydraulic motor (running at about 450 revolutions a minute) is fitted in the central trunk and raises a brass case containing the powder from the magazine to the gun-house in about 15 seconds. Two cases are provided and so arranged that one travels up while the other descends. Thus in the space of a little more than half a minute a charge for each gun can be raised from the magazine. The 12-inch guns are mounted in pairs *en barbette*, but are further protected from the enemy's fire by a heavy shield built on the turntable structure, with front plates 10 inches thick. This affords considerable protection to the guns, but without the full weight of a turret. The 6-inch guns are of the wire construction and mounted on the Elswick pedestal mounting, of which a large number are now being supplied to the Navy. They are a great improvement on former mountings, all parts being interchangeable, and admit of repair in case of damage with ease and rapidity. The 12-pounder guns and mountings, both of Elswick design, are rapidly replacing the smaller Q. F. guns, such as 6-pounder and 3-pounder, as part armament of large vessels. The whole weight of the 12-pounder gun and mounting complete with shield is only 30 cwt., and is a most effective weapon.

The Minerva.

The new second class cruiser Minerva has successfully completed her steam trials. The result of the eight hours' run under natural draught, so far as speed was concerned, were better than in any other vessel of the same class yet tried. With only a quarter of an inch pressure in the cylinder a speed of 19.6 knots an hour was obtained. The steam pressure in boilers was 151 lbs., and the I. H. P. 8221, or an excess of 221. The results of the four hours' forced draught trial were as follows:—I. H. P. 9891; mean air pressure in stokeholds, 1.02 inch; speed by patent log, 20.34 knots. On the thirty hours' continuous coal consumption trial the results were:—Steam pressure in boilers, 146 lbs. per square inch; mean I. H. P., 4,919; consumption of coal, 1.7 lb. per I. H. P. per hour. The machinery was run at half power throughout the trial. The average speed was 17.52 knots by patent log, which is nearly three-quarters of a knot more than the sister ships attained on similar trials.

The Diana.

The new second class cruiser Diana has successfully completed her trials, and even better results, both as to speed and power, were obtained than in the case of the Minerva, the performance of which ship constituted a record for this type of vessel. The results of the eight hours' run under natural draught gave a speed of 19.72 knots with 8252 I. H. P. The results of her forced draught trial also proved very successful. The engines were designed to indicate 9600 I. H. P. with a speed of 19.5 knots, but the result of a four hours' run gave a mean of 9875 I. H. P., with a speed of 20.16 knots. The result of the coal con-

sumption trial were as follows:—Speed of ship, 17.24 knots; steam pressure in boilers, 142 lbs. per square inch; revolutions per minute, 116; mean I. H. P., 4916; consumption of coal, 1.47 lb. per I. H. P. per hour.

The Powerful.

The new first class cruiser Powerful completed two of her trials successfully. She was first run for thirty hours at 5000 I. H. P., or one-fifth of her maximum H. P. The run was made between Brighton and the Start in the English Channel, and fine weather with a moderate breeze was experienced. Although in addition to the main machinery thirty-four out of the ninety-five auxiliary engines that the ship contains were in constant use, there was no difficulty in maintaining the required H. P. with sixteen out of the forty-eight boilers, and when four runs were made over the measured mile in Stokes Bay the ship made an average of 14.35 knots. In the first and third hours against the wind and with the tide the speeds, respectively, were 15.35 and 15.0, and in the second and fourth hours against the tide and with the wind, the speeds were 13.53 and 13.80, with 5200 I. H. P. The mean temperature in the stokeholds was about 85, but when going head to wind the temperature in the engine room was quite cold. The revolutions varied according to the force of wind with or against the ship from 66 to 69 per minute, and the I. H. P. ranged from 4850 to 5200, both port and starboard engines contributing a remarkable equality of power. At no period in the trial did the engines give the least trouble, whilst the highest point reached in the coal consumption was 2.6 lbs. per I. H. P., but this comparatively high rate was due to several fires and tubes being cleaned at the same time. The official report of the trial showed that the draft of water was 27 feet 3 inches forward and 27 feet 2 inches aft, and the steam in the boilers was 225 lbs. to the square inch, the vacuum being 26.8 inches starboard and 27 inches port, while the mean revolutions were 67.4 starboard and 67 port per minute. The average I. H. P. was 5008, and the speed by patent log 14 knots.

In the second trial, which was the severest any war-ship has yet accomplished, the ship steamed for thirty consecutive hours at an average of over 18,000 I. H. P. Leaving Spithead at 6 o'clock on the morning of the 13th ult., by 8.30 the engines had worked up to the stipulated H. P., and the trial then commenced. Start Point was reached by 1 o'clock, and the ship headed at once for the measured distance of twenty-three miles between Rame Head and Dodman Point, over which these runs were made at 18,000 I. H. P., at a mean speed of 20.6 knots. When darkness set in a due westerly course was taken in order to avoid the track of vessels in the Channel, and the ship steamed to a point about sixty miles beyond the Scilly Islands, where she turned and got on the measured distance on the Cornish coast at 8 o'clock the next morning. Three other runs were then made, when the engines were working at 18,650 I. H. P., and a mean speed of 21 knots was recorded. At the 5000 I. H. P. trial the coal consumption was 2.07 lbs. per I. H. P. per hour, but at the second trial it was reduced to 1.838 lb. The trial showed that, taking the coal consumption per I. H. P. per hour as the criterion, 15,000 I. H. P. would give the economical speed, while a careful calculation proved that during the trial the cost of producing the steam, including coal and labor, was an infinitesimal fraction under one penny per revolution, each revolution propelling the ship a

TABLE II.

NEW VESSELS PLACED IN COMMISSION MARCH 4, 1893, TO MARCH 4, 1897.

Name.	Type.	Displacement.	Main battery.	Date of first commission.
		Tons.		
Indiana	Sea going coast-line battle ship	10,288	4 13″ B. L. R.; 8 8″ B. L. R.; 4 6″ B. L. R.	Nov. 20, 1895
Massachusetts	. . . do.	10,288	. . . do.	June 10, 1896
Oregon	. . . do.	10,288	. . . do.	July 15, 1896
Maine	2d class battle ship	6,682	4 10″ B. L. R.; 6 6″ B. L. R.	Sept. 17, 1895
Texas	. . . do.	6,315	2 12″ B. L. R.; 6 6″ B. L. R.	Aug. 15, 1895
New York	Armored cruiser	8,200	6 8″ B. L. R. 12 4″ R. F. G.	Aug. 1, 1893
Brooklyn	. . . do.	9,271	8 8″ B. L. R.; 12 5″ R. F. G.	Dec. 1, 1896
Amphitrite	Low free-board coast defense monitor	3,990	4 10″ B. L. R.; 2 4″ R. F. G.	April 23, 1895
Monadnock	. . . do.	3,990	. . . do.	Feb. 20, 1896
Terror	. . . do.	3,990	4 10″ B. L. R.	April 15, 1896
Katahdin	Armored ram	2,155	4 6-pdr. R. F.	Feb. 20, 1896
Total		75,457		
Cincinnati	Protected cruiser	3,213	10 5″ R. F. G.; 1 6″ B. L. R.	June 16, 1894
Raleigh	. . . do.	3,213	. . . do.	April 17, 1894
Columbia	. . . do.	7,375	1 8″ B. L. R.; 2 6″ B. L. R.; 8 4″ B. L. R.	April 23, 1894
Minneapolis	. . . do.	7,375	. . . do.	Dec. 13, 1894
Olympia	. . . do.	5,870	4 8″ B. L. R. 10 5″ R. F. G.	Feb. 5, 1895
Detroit	Cruiser	2,089	9 5″ R. F. G.	July 20, 1893
Marblehead	do.	2,089	9 5″ R. F. G.	April 2, 1894
Montgomery	do.	2,089	9 5″ R. F. G.	June 21, 1894
Castine	Gunboat	1,177	8 4″ R. F. G.	Oct. 22, 1894
Machias	do.	1,177	8 4″ R. F. G.	July 20, 1893
Total		35,667		
Puritan	Low free-board coast defense monitor	6,060	4 12″ B. L. R.; 6 4″ R. F. G.	Will be commissioned December 7, 1896.
Annapolis	Gunboat	1,000	6 4″ R. F. G.	Will be commissioned February 20, 1897.

TABLE III.

NEW TONNAGE AUTHORIZED BY CONGRESS AND NEW TONNAGE BEGUN AND PLACED IN COMMISSION SINCE MARCH, 1881.

March 4—	New vessels authorized.	New vessels begun.	New vessels commissioned.
	Tons.	*Tons.*	*Tons.*
1881-1885	23,076	12,363	. . .
1885 1889	67,183	34.814	7,863
1889-1893	66,618	93,164	54,832
1893-1896*	65,942	80,778	118,184

*To this table is to be added vessels that may be authorized during the coming session of Congress.

TABLE IV.

TABLE OF PRESENT STRENGTH OF SEVEN PRINCIPAL NAVIES.

Class.	England.			France.			Russia.			Italy.			Germany.			United States.			Spain.		
	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.
Battle Ships:																					
1st class	22	12	34	10	8	18	5	6	11	8	2	10	4	2	6	3	6	9	1	..	1
2d class	12	..	12	11	1	12	5	2	7	2	..	2	7	..	7	2	..	2	..	.	..
3d class	11	..	11	2	..	2	..	.	..	5	..	5	3	..	3	..	..	..	2	..	2
Total	45	12	57	23	9	32	10	8	18	15	2	17	14	2	16	5	6	11	3	..	3
Coast defense ships	13	..	13	16	..	16	10	4	14	..	..	..	17	2	19	6	1	7	..	.	..
Cruisers:																					
Armored	16	..	16	9	1	10	9	1	10	1	5	6	..	1	1	2	..	2	3	4	7
1st class	11	10	21	2	4	6	2	..	..	..	..	..	1	..	1	3	..	3	1	..	1
2d and 3d class	51	24	75	10	9	19	3	1	4	16	1	17	3	5	8	13	..	13	7	..	7
Lookout ship or gunboats	19	..	19	12	..	12	..	..	..	..	..	..	11	1	12	9	9	18	22	..	22
Torpedo gunboats	34	..	34	12	3	15	8	..	8	15	2	17	9	1	10	..	..	..	3	4	7
Torpedo boat destroyers	..	..	98	..	..	3	..	..	1	..	..	1	..	..	11	..	..	1	..	2	2
Torpedo-boats	..	..	160	..	..	241	..	..	161	..	..	176	..	..	145	3	15	18	19	4	23

Comparison of the Latest Battle-Ships of the Principal Naval Powers.

	Nation.					
	United States.	England.	France.	Germany.	Russia.	Italy.
Name of Vessel	"Alabama."	"New Renown."	"St. Louis."	"Ersatz Preussen."	"Oslabya."	"St. Bon."
Length	368 ft.	390 ft.	385 ft.	397 ft.	402 ft.	344½ ft.
Beam	72	74 "	66½ "	66.93 "	70½ "	69½ "
Mean draft	23 ft. 6 ins.	25 ft. 5 ins.	25 ft. 11 ins.	25 ft. 9 ins.	26 "	24 ft. 9 ins.
Displacement, tons	11,500	12,900	11,275	11,130	12.674	9,800
Indicated horse-power	10,000	15,000	14,500	13,000	14,500	13,500
Speed	16 knots.	18¾ knots.	18 knots.	18 knots.	17½ knots.	18 knots.
Coal, normal	800 tons.	...... tons.	680 tons.	650 tons.	...... tons.	...... tons.
Coal, maximum	1,200 "	1,850 "	1,100 "	...... "	...... "	1,000 "
Battery: Main	(4) 13-in. (14) 6-in.	(4) 12-in. (12) 6-in.	(4) 12-in. (10) 5½-in. (8) 3.9-in.	(4) 9½-in. (18) 6-in. (12) 3½-in.	34 guns.	(4) 10-in. (8) 6-in. (8) 4.7-in.
Battery: Secondary	(17) 6 pdrs. (6) 1 " (5) machn.	(16) 12 pdrs. (12) 3 " (2) machn.	(16) 1.8-in. (10) 1.4-in. (8) machn.	(12) 6 pdrs. .... (8) machn.		(2) 2.9-in. (12) 1.4-in. (2) machn.
Torpedo tubes	4	5	4	....	....	5
Armor: Belt	16½ ins.	8 ins.	15¾ ins.	11¾ ins.	9 ins.	9¾ ins.
Casemate	5½ "	6 "	3 "	5.9 "	....	4 "
Turrets	17-15 "	10 "	15¾ "	9.8 "	....	9¾ "
Barbettes	15 "	10 "	...... "	9.8 "	....	9¾ "
Protective deck	3 "	3 "	3½ "	2 56 "	....	3 "
Splinter deck	½-in.	....	...... "	¾ "	....	...... "

three companies named. The new vessels are to be 435 feet long, 69 feet beam, by 39 feet 9 inches moulded depth. They will have forecastle and a boat deck, but no poop. At 25 feet 3 inches draft the displacement will be 11,000 tons. The armament will consist of sixteen 6-inch quick-firers, twelve 12-pounders of 12 cwt., two 12-pounders of 8 cwt., three 3-pounders, eight .45-inch Maxims, with two submerged torpedo tubes, and one above water at the stern. The protection will be by a 3-inch and 4-inch deck, having a rise of 10 feet, with coal bunkers below and above the deck, along the sides of the machinery and boiler compartments. There will be two sets of four-cylinder triple expansion engines, the diameters of cylinders being 34 inches, 55½ inches, and two of 64 inches, with a 48-inch stroke. Instead of having the high pressure cylinder forward, with the intermediate next, and the two low pressure aft, it is proposed to put a low pressure cylinder at each end, with the view of economizing space. The engines, too, will run faster than those in the class now building—120 instead of 110 revolutions—so that the power will be increased from 16,500 to 18,000 indicated horse-power, giving 20¾ instead of 20¼ knots. The Belleville boilers will be slightly different. Over the ordinary series of elements there will be a corresponding number of elements, of smaller tubes (2¾ inches in diameter) forming economizers, and between the two a combustion chamber into which air will be injected by nozzles. This has been adopted to improve the circulation, and consequently the economy. There will be 30 boilers in all, 18 of them with eight large and eight small elements, and 12 with seven elements. The total heating surface will be 47,880 square feet, of which 15,505 square feet will be in the feed-heating tubes. The total grate area will be 1390 square feet. The steam pressure at the boilers will be 300 lbs., and at the engines 250 lbs. The contract price for each cruiser is said to be about £445,000.

[FRANCE.]

THE GAULOIS.

The new first class battle-ship Gaulois was launched at Brest, October 6; she is a sister ship of the Saint Louis, launched at L'Orient, September 8, and of the Charlemagne.

The Gaulois has been only 10 months on the stocks; she will, however, scarcely be completed before the middle of 1899. Her dimensions are as follows:—Length, 385 feet 6 inches; beam, 66 feet 6 inches; and with a draft of 27 feet 6 inches the displacement is 11,275 tons. Four 30-centimetre (11.8-inch) guns are mounted in pairs in turrets, one forward and one aft, protected by 15.7-inch armor, and can be worked either by hand or electricity; and there are ten 5.5-inch Q. F.'s, of which eight are in a redoubt on the upper deck in angle ports, four for stern fire, separated by steel splinter bulkheads and with 3 inches of steel for protection, and the other two in sponsons on the spar deck, where also are eight 3.9-inch guns. On the superstructure and in the two fighting masts sixteen 1.8-inch and eighteen 1.4-inch guns are mounted. The ship has an end-to-end belt of Harveyized steel, 6 feet 7 inches deep, the extremities being of special nickel or chrome steel, with a maximum thickness of 15.7 inches amidships, surmounted by another light belt 3 feet 3 inches wide of 3-inch nickel steel, and there are two steel decks (3.5-inch) severally at the level of the top and bottom of the

main belt, the intermediate space being subdivided for coal stowage. Three triple expansion engines, driving as many screws, are supplied by twenty sets of Belleville boilers, with a maximum of 14,000 H. P. (forced draught), giving a speed of 18 knots. The extreme coal capacity is 1000 tons, but the normal coal supply is only 570 tons.

The Catinat.

The second class cruiser Catinat was launched at Havre, from the yard of the Société de la Mediterranée, on October 8. She is a sister vessel to the Protet now building by the Société de la Gironde at Bordeaux, and her dimensions are as follows:—Displacement, 4065 tons; length, 101 metres (330 feet); beam, 14 metres (45 feet 6 inches); mean draft of water, 6 metres (19 feet 6 inches). She has twin screws worked by triple expansion engines of 9000 I. H. P., and her estimated speed is 19 knots; the engines are vertical triple expansion and the boilers are of the Belleville water-tube type. The coal supply is 384 tons, giving a radius of action of 6000 miles at 10 knots and 1000 miles at full speed. For protection there is a 2.5-inch steel deck, and the guns have 2-inch steel shields. Her armament comprises four 16-centimetre (6.2-inch) guns, four 10-centimetre (3.9-inch), ten 47-millimetre and ten 37-millimetre, all Q. F.'s, and she has two submerged torpedo tubes. She is to be completed in February, 1897, and her total cost is 8,079,302 francs.

The new second class cruiser Pascal has been undergoing her trials at Toulon. With the engines developing 7232 I. H. P., a mean speed of 18.5 knots was maintained for three hours, the consumption of coal per I. H. P. per hour being 0.838 kilogramme, and for a square metre of grate surface per hour 93.019 kilogrammes.

The new torpilleur-de-haute-mer Mangini, at her trials off Lorient, attained a speed of 27 knots, exceeding the contract speed by 2 knots; she has been built by the Société des Ateliers de la Loire.

The new torpedo-depot-ship Foudre, at her full speed forced draught trials, maintained a mean speed of 19.9 knots for the three hours; it has not been definitely decided to what use she is to be turned.

Gun Trials of the Dragonne.

The not (it would seem) very novel idea of mounting a single heavy gun in a small vessel was first proposed during the ministry of the late Admiral Aube in 1886, and a small vessel of 80 tons, named the Gabriel Charmes, was constructed to mount a gun of 14 centimetres (5.5 inches). The trials with this vessel, however, did not excite any special interest and the matter dropped. Under M. Lockroy's ministry the idea was taken up, but instead of constructing a special vessel, the Dragonne, of 395 tons, was utilized, and a shell gun of 155 millimetres (6 inches) mounted on a land carriage was placed on board.

The object of the trials was to demonstrate the advantages of this method of operating against land defenses, especially when the latter were placed at an altitude and are consequently beyond the reach of the ordinary sea fire. The experiments have been fairly successful. The

Dragonne is a vessel of 395 tons, and the trials were carried on in a swell which rolled her 10 deg. Ten shots were fired at a distance of 5200 m., five at anchor and five running fire, and high explosives were used. They all fell within a rectangle of 400 m. on the shores, a result that would have done serious harm to a large fort on the coast, whereas the fire of the fort would have been practically useless against a slight moving object like the Dragonne.

The second trials made a few days later were equally satisfactory. They were made at night, against the old transport Panama, at a range of about 400 metres. There was a heavy sea on and yet half of the projectiles struck the target.

Ship Building Notes.

The Minister of Marine has placed an order with the Normand firm of Havre for a new torpilleur-de-haute-mer of 1250 tons with a speed of 30 knots, to be called the Cyclone, and for two torpedo-avisos of 300 tons, to be called the Durandal and Hallebarde, which are to have a speed of 26 knots. In view of the miscalculation regarding the stability of some of the recent French war vessels, the Minister of Marine has also created a special commission whose duty it will be to study at six months intervals the changes in the condition of the stability of ships under construction as fresh material is worked into them.

Some particulars are given in the French newspapers of the new French battle-ship Henri IV, from which it appears that there have been very considerable modifications in the original design. As she now stands she will be a first class battle-ship of 8948 tons, 353 feet long, 73 feet in beam, armed with two 11-inch guns, seven 5.5-inch, and twelve 1.8-inch quick-firers. She will have three screws, and engines of 11,500 horse-power, which will give her, at natural draught, a speed of 17 knots. She has two submerged torpedo tubes. Her keel was laid at Cherbourg in July. Eighty thousand pounds will be expended upon her in 1897, and she will join the fleet in 1901. As far as can be gathered, she will be of the Jemmapes type, modified and improved. A similar ship is to be laid down at Brest in 1897.

Naval Budget for 1897.

It is stated that the programme of naval construction proposed by the French Government and approved by the Budget Commission comprises the following vessels:—One battle-ship, one first class cruiser, two first class cruisers for coast defense, one third class cruiser for coast defense, one gunboat, one torpedo boat destroyer, and two first class torpedo boats.

The battle-ship A3 will be built at Brest and will be similar to the Henri IV building at Cherbourg. Her displacement will be 9000 tons; she will have water-tube boilers, and her speed is to be 17 knots; her armament and its disposition on board have not yet been settled; cost, exclusive of armament, 18,449,400 francs.

The first class cruiser C3 will be built at Toulon; she will be an armored cruiser, similar to the Jeanne d'Arc building at that port. Her displacement will be 11,270 tons, with a length of 460 feet and a beam of 61 feet. The engines will be vertical triple expansion, driving

three screws, and the boilers are to be of the Normand water-tube type, while the engines are to develop 28,500 I. H. P.; speed, 23 knots; radius of action at 10 knots, 13,500 miles, and 2000 miles at full speed. Armament—two 19-centimetre (7.4-inch), eight 14-centimetre (5.5-inch) Q. F., twelve 10-centimetre (3.9-inch) Q. F. guns, and twenty-four 3-pounder and 1-pounder Q. F. guns, with two under-water torpedo tubes; cost, 24,673,771 francs. She will be wood-sheathed and coppered.

One of the first class station cruisers, D2, will be built at Lorient, the other by a private firm of shipbuilders. Displacement 5500 tons, with a length of 438 feet and a beam of 48 feet. The engines are to be vertical triple expansion, driving three screws and developing 17,100 I. H. P., and the boilers will be Normand water-tube, giving a speed of 23 knots. Armament—eight 16-centimetre (6.2-inch), twelve 47-millimetre guns, and two submerged torpedo tubes; cost, 10,674,811 francs. They also will be wood-sheathed and coppered.

The third class coast defense cruiser will be a sister vessel to the D'Estrées, in course of construction at Rochefort. Its displacement will be 2452 tons, its engines will be of 8500 horse-power, and its speed 20.5 knots. Its armament will consist of two guns of 14-centimetres, four of 10 centimetres, and eight of 47 millimetres.

The plans of the destroyer M2 are not yet completed, but she will have a speed of 26 knots, and the radius of action of 2500 miles at 10 knots.

The gunboat is intended for distant stations, and will be constructed by a private firm on the lines of the Surprise. It will have a displacement of 629 tons and a speed of 13 knots. It will be equipped with two guns of 10 centimetres, four of 65 millimetres, and four of 37 millimetres. All the guns of the new vessels, beginning with those having a calibre of 16 centimetres, will be quick-firing.

[Russia.]

The Rotislav.

[Journal of the Royal United Service Institution.]

A further advance has been made towards the strengthening of the already formidable Black Sea fleet by the launch at Nicolaieff, in the presence of H. I. H. the Grand Duke Alexis, Commanding Admiral of the Russian Navy, of the new first class battle-ship Rotislav. Her dimensions are as follows:—Length, 341 feet; beam, 66 feet 6 inches; and with a draft of 24 feet she will displace 8880 tons. Protection is afforded by a belt of compound armor which extends nearly four-fifths the length of the ship, reaching 3 feet 3 inches above the same below the water line, and is 16 inches thick amidships, tapering to 12 inches at the extremities; above this belt rises a central redoubt, 150 feet long, protected by 5-inch armor, with armored transverse bulkheads of the same thickness; the armored deck is 3 inches thick, tapering to 2 inches. There are two vertical triple expansion sets of engines, with sixteen cylindrical boilers, which are to develop 8500 I. H. P. under forced draught, giving a speed of 15 knots. The normal coal stowage is 550 tons, but 800 tons can be carried on an emergency, giving a radius of action of 2000 sea miles at 10 knots. The armament consists of four 12-inch guns in couples in turrets, one forward and one aft, protected by 12-inch armor tapering to 10 inches; each pair of guns has an arc

not exceed this figure. When used as a graving dock for short heavy ironclads its lifting power can be increased to 12,000 tons or more, providing the length of the vessel does not exceed 383 feet. That is to say, it could dock vessels such as the Inflexible or Renown of our own navy, or the Brennus and Jauréguiberry of the French navy. It is to be capable of lifting a vessel of 10,000 tons clear of the water in 150 minutes. It is to be built of mild steel throughout, and is so designed as to be self-docking in all its parts. It will be built in England and towed out to its destination. The dock is to be delivered in complete working order at Havannah 11 months after the signature of the contract, and the contract price is £119,000.

[HOLLAND.]

DUTCH NAVAL PROGRAM.

[ENGINEERING.]

The Dutch Government has published a program of reorganization of the Navy. According to this program 12 protected cruisers will be built of the same type as the three cruisers now building, except that the armor shields for the guns of 15 and 12 centimetres will be made 150 millimetres (6 in.) thick and those of the 7.5 centimetre guns will be made 75 millimetres (3 in.) thick. The speed of these cruisers is to be 23 knots, the same as the speed of the Holland, Friesland, and Zeeland now building. Six armored vessels are also proposed of the same type as the Kortenaer, the Evertsen, and the Piet Hein, which went into commission at the end of last year and in the beginning of this year. Some modifications will be made, however, in the armament, viz., instead of three guns of 21 centimetres, 32 calibres, there will be two guns of 24 centimetres and 40 calibres, each of them in a barbette tower; two quick-firing guns of 15 centimetres will be replaced by four quick-firing guns of 12 centimetres, protected by closed shields of 5-centimetre steel. Their displacement will be 3936 tons with 17 feet 6 inches draft. The engines, of 5300 indicated horse-power, are to give a speed of at least 16 knots. The 12 cruisers are destined for the colonies, together with the three cruisers building. The six armored steamers and the three that lately went into commission are intended for the defense of the country. For coast defense, three monitors, type A (larger type, about the same type as the Reinier Claessen), and three monitors, type B (smaller type) are proposed, together with 15 gunboats, 15 torpedo boats, type A (30 knots), six torpedo boats, type B (23 knots), and 10 torpedo boats, type C (18 to 20 knots). For protection of the fishermen three schooners are proposed. The monitors, type A, will have a displacement of 1500 tons, a protective deck of 50 millimetres (2 in.) thick, 200 millimetres (8-in.) armor, two guns of 21 centimetres, 40 calibres long, in two barbette towers, four quick-firing guns of 7.5 centimetres, protected by 25-centimetre (10-in.) shields, four quick-firing guns of 3.7 centimetres. The engines are to develop 700 indicated horse-power. Speed to be at least 9½ knots. Bunker capacity 60 tons. Draft 10 feet 4 inches. The monitors, type B, to have a displacement of 1406 tons, a protective deck of 50 millimetres (2-in.) thick, armed with one gun of 21 centimetres (40 calibres long), in a barbette forward, 200 millimetres (8-in.) armor, 150-millimetre (6-in.) shields, one quick-firing gun 12 centimetres (40 calibres long) aft, with a closed shield of 50 millimetres (2-in.) thick-

ness; four quick-firing guns of 7.5 centimetres, with shields of 25 millimetres (1-in.); four quick-firing guns of 3.7 centimetres; 680 indicated horse-power, 9½ knots speed, 60 tons bunker capacity, draft 9 feet 8 inches. The gunboats to have a displacement of 475 tons, with a protective deck of 25 millimetres thickness, four quick-firing guns of 7.5 millimetres, protected by shields of 25 centimetres, four quick-firing guns of 3.7 centimetres, 550 indicated horse-power, 11¾ knots speed, 23 tons bunker capacity, draft not to exceed 8 feet 4 inches. Torpedo boats, type A, displacement 130 tons, two quick-firing guns of 3.7 centimetres, two torpedo tubes, 15 tons bunker capacity, and 30 knots speed. Torpedo boats type B to be the same as the Dutch torpedo boats named with the letters from A to N. Torpedo boats type C to be of the type as the Dutch torpedo boats designated by figures from III to XXII. The naval estimate for the building of these cruisers is 80,535,000 guilders, or say £6,750,000. The Dutch fleet is manned by 715 officers and about 10,000 non-commissioned officers and men, in addition to the Government navy in India.

		Guilders.
Estimated cost of each	cruiser	2,925,000
" " "	armored vessel	3,640,000
" " "	monitor, type A	1,520,000
" " "	monitor, type B	1,280,000
" " "	gunboat	350,000
" " "	torpedo boat, type A	460,000
" " "	" type B	170,000
" " "	" type C	60,000
" " "	schooner	475,000

[Brazil.]

Amazonas.

The Amazonas, cruiser, built to the order of the Brazilian Government, was launched by Sir W. G. Armstrong and Co., Elswick, Newcastle-on-Tyne, on December 4. She is a sister ship of the Barrozo, launched in August. The Amazonas is built entirely of steel and is sheathed with wood and copper. She is protected by a steel armor deck. The vessel will be fitted with machinery of 7500 indicated horse-power, and is expected to attain a speed of 20¼ knots with natural draught. The bunkers when full will carry 700 tons of coal, enabling the ship to traverse about 8000 knots when cruising at a moderate speed. Her dimensions are:—Length, 330 feet; breadth, 43 feet 9 inches; mean draft, 16 feet 10 inches; displacement, about 3450 tons. The armament will comprise six 6-inch quick-firing guns, four 4.7-inch quick-firing guns, ten 6-pounder quick-firing guns, four 1-pounder quick-firing guns, four Maxim guns, and three torpedo tubes.

[Chili.]

Capitan Orella.

Messrs. Laird Brothers, of Birkenhead, on the 30th of September took out the Capitan Orella, the first of the 30-knot destroyers they are building for the Government of Chili, and made her full power official trial on the Clyde. The mean speed obtained on six runs was 30.17 knots,

with 361 revolutions, and the average revolutions for the three hours were 362.5, giving a somewhat higher average speed of 30.23 knots for the continuous running. There was a fresh breeze from the south and a lumpy sea, but the vessel proved a very steady sea boat, and much satisfaction with her performance was expressed by Captain Romulo Medina, who represented the Chilian Naval Commission, and the other Chilian officers who were on board.

MUNOS GAMERO.

On October 15 was held the trial trip of the Capitan Munos Gamero, the second of the four torpedo boat destroyers building at the works of Laird Brothers for the Chilian Government. On the measured mile the speed averaged 30.42 knots with 369 revolutions, and on the 3 hours' run the speed averaged above 30 knots with 364 revolutions.

There was launched from the yard of Messrs. Yarrow and Co., Poplar, on December 3, the first of six first class torpedo boats which are being constructed by this firm for the Chilian Government. These torpedo boats are of the Viper type.

[ARGENTINE.]

TORPEDO BOAT DESTROYERS.

THE ENTRE-RIOS.

The results of the three hours' trial with the usual six runs gave a mean speed of 26.75 knots with 365 revolutions, as shown by following table:

Hour.	Steam.	1st Receiver.	2nd Receiver.	Vac.	Air forward.	Air aft.	Revolutions.	Time.	Speed.
h. m.	lb.	lb.	lb.	in.	in.	in.		m. s.	knots.
11 34	148	67.5	10.5	25	1.5	1.75	368.0	2 18	26.087
11 44	150	65.5	10.0	25	1.5	1.75	370.0	2 9	27.907
11 52	150	67.0	10.0	25	1.5	1.75	369.5	2 18	26.087
12 2	146	62.5	9.5	25	1.5	1.75	364.0	2 10	27.693
12 11	145	61.0	9.25	25	1.5	1.75	358.5	2 23	25.175
12 20	145	60.0	8.5	25	1.5	1.75	361.0	2 10	27.693

THE MISIONES.

The Misiones, another of the Argentine armored torpedo boat destroyers built by Messrs. Yarrow and Co., was taken out for its official trial at the mouth of the Thames, October 9. A three hours' full speed run was made, loaded with 35 tons, when a mean speed of 27.1 knots was realized, being 1.1 knots in excess of the contract speed of 26 knots. The Argentine Government was represented by Captain Diaz, Chief of the Commission; Mr. Hughes, Engineer to the Commission; and Lieutenant Barbara. Steam was supplied by six of Yarrow's patent water-tube boilers. The consumption of coal on the three Argentine destroyers tried up to this date compares most favorably with the results obtained in similar vessels in the British Navy. In the case of the Santa Fé the

consumption on the three hours' full speed run was 9¾ tons, on the Entre Rios it was 10½ tons, and on the Misiones it was 11¼ tons.

The Corrientes.

The fourth of the torpedo boat destroyers constructed within 12 months from the date of laying the keel was launched with engines and boilers on board, October 10, and the official trials took place on November 18, with following results:—draft, aft, 4 feet 11 inches; forward, 3 feet 11 inches; mean, 4 feet 5 inches. The load was 35 tons, and there were 56 persons on board. The boat left Gravesend at 10.7 and returned at 3.35. At starting the coal on board was 22 tons, and the total burnt in 3 hours was 10 tons 13 cwt. The automatic feed worked perfectly. The following table gives the results:

Time of Day.	Steam.	Pressure in First Receiver.	Pressure in Second Receiv'r	Vacuum.	Air.	Mean Revolutions.	Time on Knot.	Speed.	Mean of Means.
h. m.	lb.	lb.	lb.	in.	in.		h. m.		
11 4	157½	67	11	25	1½	379	2 12	27.272	27.359
11 14	150	67	10½	24½	⅜	375	2 9	27.906	
11 26	152½	69	10½	25	1	376	2 10	27.692	
11 37	148	64	9½	25	1¼	364	2 15	26.666	
11 48	150	63½	10	24	1¼	367	2 10	27.692	
11 56	150	67	10½	24½	1⅜	372	2 15	26.666	

The mean revolutions on the miles were 372, and the mean speed on miles was 27,359. The three hours' trial commenced at 10 hours 33 minutes, and on arrival at the Maplins, 6 miles were run as above. During the three hours the average steam pressure was 151 lbs., and the engines made 67,090 revolutions, equal to 372.7 per minute; average speed, 27.410 knots. The boilers and engines worked perfectly.

[China.]

A number of torpedo boats, built at the Schichau Works, were delivered to China in the past year, reaching their destination in about 30 days. In consequence of the satisfactory trial trips which followed their arrival, new orders were placed by the Chinese Government.

Four new torpedo cruisers are ordered in Elbing, to make 32 knots, with 6500 H. P. The hulls to be of nickel steel, boilers and engines to be of the Schichau type. They are to be completed in 13 months and to proceed to China under their own steam.

BOOK NOTICES.

THE PROGRESS OF ARTILLERY. NAVAL GUNS. By James Atkinson Longridge. E. F. Spon, London. Spon & Chamberlain, 12 Cortlandt Street, New York.

The substance of Mr. Longridge's "Progress of Artillery" may be summed up in the following propositions:

1. A very great increase of ballistic power has resulted from the use of so-called smokeless powders, due to the fact that these powders are entirely converted into gas, whereas of the old charcoal powders only 43 per cent. is so converted.

2. A still further increase of ballistic power can only be obtained by the discovery of a more powerful powder; by a modification of the gun; or by allowing higher pressures in our present guns.

3. The discovery of a more powerful powder is unlikely, as it would have to be an explosive of a nature as yet unknown to our chemistry. Modifications of the gun, such as lengthening bore and increasing chamber capacity, are at the expense of lightness and mobility, already too much sacrificed.

4. Consequently the only practicable way of obtaining a further great increase of ballistic power is by increasing our working pressures.

5. This can be done safely now that we are using wire wound guns.

Probably most persons who have studied ordnance questions will agree in the main with all the foregoing propositions, but it by no means follows that the results which Mr. Longridge thinks should ensue are, as he believes, postponed only by conservatism. In the first place, it is not lack of strength which prevents the adoption of higher pressures with our present guns, but the fact that the erosion of the bore increases rapidly as the pressure increases. We use moderate working pressures so as to prevent our guns from being worn out by the number of shots that would perhaps be fired in a single action.

In the second place, it is very doubtful if the wire gun is any stronger than the built-up one. The elastic strength of the wire is, to be sure, greater than that of the steel rings it replaces, but it must be remembered that the wire can only be made in comparatively short lengths, and consequently must be frequently spliced, and it is the strength of the joint, always much less than that of the wire itself, which determines the strength of the wire layer as a whole. Again, it is really the elastic strength of the tube itself which limits the safe pressure in the bore, and the hoop forgings which are now used, in the United States at least, are amply strong to allow the tube metal to pass from the limit of elastic compression to that of elastic extension, without being themselves unduly strained.

Mr. Longridge's views in regard to rifling of increasing twist are not in accord with those usually held, and appear to have no good founda-

tion. Neither does Mr. Longridge's easy acceptance of the statements of the makers of ammonium nitrate powders afford a sufficiently good reason for the reader to consider that they have completely solved the problem of making a cheap, reliable, low temperature, high power, smokeless powder, better than anything any one else has yet made. Generally speaking, Mr. Longridge appears to take too narrow a view of things and to be too much of the opinion that people who do not agree with him are behind the times. A great deal can be said in opposition to his various propositions, such as the reduction of calibre of naval guns, and the reader should not accept them as authoritative without studying the opinions of those who have had the practical experience in ordnance matters which the author evidently lacks.

P. R. A.

THE HOTCHKISS AUTOMATIC MACHINE GUN (RIFLE CALIBRE). Harrison and Sons, St. Martin's Lane, London.

This pamphlet gives full description with copious plates and illustrations of the Hotchkiss Automatic Machine Gun, rifle calibre. This new gun, in general design and in detail, is a radical departure from all former types. The first round is fired by hand, after which the operations of loading, firing and extracting are carried on automatically, but under complete control of the gunner. Slow fire may be delivered at any rate up to about 100 rounds per minute, and rapid fire from 500 to 600 rounds per minute. It may be arranged to fire any of the forms of small arm ammunition in service. The weight of the gun is 33 lbs.

The general description of the gun is as follows:

The gun consists of a single barrel, screwed into the front of the receiver which contains the operating mechanism; below and parallel to it is secured a hollow cylinder, which is in communication with the bore through a port drilled through the barrel, a few calibres from the muzzle. Contained in this cylinder is a piston on which are formed suitable cams for operating the breech block, the firing and the feed mechanism. On discharge, as soon as the bullet has passed the port connecting bore and cylinder, the powder gas enters a chamber in the front end of the cylinder and throws the piston to the rear, where it is held by an ordinary sear. On releasing the sear, by pressing the trigger, the piston is thrown forward to its initial position by the main spring. It is obvious that if the sear is held out of engagement by pressing the trigger, and the supply of cartridges be kept up, the piston will have a constant reciprocating motion.

The piston engages with the breech block, and by its motion opens the breech, pushes the cartridge into the chamber, closes the breech and fires. On opening the breech it extracts the fired cartridge case, and brings a fresh cartridge to the loading position, performing, in other words, the functions of a soldier's hand when operating a straight pull rifle.

The cartridges are carried in flat brass feed-strips, having a length of about 38 centimetres and each containing thirty rounds. Each feed-strip is packed in an ordinary pasteboard box, from which it is fed directly through the gun.

The feed mechanism consists of a feed-wheel which engages in cams cut in the piston, and register with openings formed in the feed-strip; each backward and forward motion of the piston brings a fresh cart-

ridge in line with the chamber ready to be pushed home by the breech block and fired.

The gun is fitted with a shoulder-piece or stock, which the gunner brings to his shoulder, and with a pistol-grip and trigger for controlling the fire. Aiming and firing are therefore carried out, as in all Hotchkiss guns, with the same facility as when firing a rifle from a rest.

Two men are required to work the gun, one to load and the other to fire, but a single man can work it in case of necessity.

H. G. D.

DER KRIEG OESTERREICHS IN DER ADRIA IM JAHRE 1866 (Austria's war in the Adriatic in 1866). Seekriegsgeschichtliche Studie verfasst von Ferdinand Ritter von Attlmayr, gewesener K. K. Corvetten Capitan im Flaggen Stabe des Vice Admirals W. von Tegetthoff. Published by the editors of Mittheilungen aus dem Gebiete des Seewesens, Pola.

The above interesting historical study of the conflict between the Austrian and Italian navies in 1866 is a very valuable contribution to naval history. The work of some 200 pages is illustrated with 4 heliotypes from portraits, 14 photo-engravings, 5 charts and 11 diagrams. Particular attention is called to the two-page engraving that represents the sinking of the Re' d'Italia, at the battle of Lissa, by the Austrian flagship Erzherzog Ferdinand Max; it is a copy of the painting by the famous marine painter Bolamachi.

The author, from having been a commander in the Austrian Navy at the time, having been personally identified with the preparations for the war and actively taking part in it as a member of the personal staff of Admiral Tegetthoff, is especially competent to give a true account of the events of those stirring few months. In the preface he states that the work is a study as well as history, his aim having been to render an impartial account of the occurrences, from which follow natural deductions and conclusions relative to naval strategy and policy. In preparing the work resort was had to official reports and documents at Vienna, the accounts of participants and personal recollections. For Italian sources of information were used Randaccio's Storia della Marina militare Italiana dal 1860 al 1870, and other reliable Italian works notable for their impartiality.

The first chapter is devoted to the condition of the Austrian Navy in the spring of 1866. It considers the military problem confronting the fleet, and the nature of its defensive operations in prospect of the approaching war.

The second and third chapters deal with the equipment and preparations of the Austrian fleet for the war, with events up to the battle of Lissa.

The fourth chapter is devoted to the preparations and operations of the Italian fleet up to date of the battle of Lissa. The last chapter is a detailed description of the battle of Lissa.

The whole work breathes the admiration of the author for Vice-Admiral Wilhelm von Tegetthoff, to whom the book is dedicated. It shows how the unceasing efforts of Tegetthoff, in face of apathy and reluctance of the authorities at Vienna, finally succeeded in having the fleet mobilized. The state of the Austrian Navy as late as the middle of April, 1866, was appalling. But by constant urging and ceaseless work the armored ships were completed in the course of a few weeks, wooden

vessels strengthened by outside extemporized armor of cable or rails, and a squadron collected with Fasano channel as a base of operations. Unceasing drills and exercises, especially at concentrated fire, were held, and as soon as a nucleus of a fleet was obtained, drills underway, tactical and divisional evolutions were pushed. The ceaseless activity of the leader inspired emulation in all his juniors, and even with the few weeks of preparation the Austrian fleet was ready to meet its superior opponent.

The author's account of the battle of Lissa will become the standard one to be referred to by students of naval engagements. The careful attention to details, the impartial relating of the stirring events of that July morning will recommend itself to every reader, impressing him with its authenticity.

H. G. D.

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No. XV of the General Information Series, Office of Naval Intelligence. Information from Abroad.

This number contains 235 pages of interesting data profusely illustrated, divided under seven separate parts, as follows:—I. Notes on ships and torpedo-boats. II. Notes on ordnance and armor. III. Notes on small arms. IV. Notes on boilers. V. Notes on voice tubes. VI. Notes on cellulose. VII. Naval manœuvres, 1895.

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OCTOBER 31. Bullets Fused by Impact. The Danube Ship Canal. The Ocean Mail Service.

NOVEMBER 7. A New Port for Russia. St. Paul and Lucania.

NOVEMBER 14. The German Kite Balloon. Preventing Boiler Incrustation.

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NOVEMBER 28. French Experiments with Melinite. Wire Gun Construction. The Brown Wire-wound Gun.

DECEMBER 5. Armor vs. Shot. New Harbor Mail Transport. American Shipbuilding. Tests of Smokeless Powders.

DECEMBER 12. Modern Application of Storage Battery. Massachusetts Turret Tests.

DECEMBER 19. Japan's Merchant Marine. Armored Torpedo-boats.

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SEPTEMBER-OCTOBER, 1896. On the Rifling of Cannon. Notes on European Sea-coast Fortifications. The Bicycle and its Adaptability to Military Purposes. History of the Sea-coast Fortifications of the United States—I., Portland, Maine. Resistance of Air to the Motion of Projectiles.

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JUNE-SEPTEMBER, 1896. Description and Computation of a Twenty-four Hour Duty Test on the Twenty Million Gallon Leavitt Pumping Engine at Chestnut Hill. Notes on the Best Form of Cross-section for the Coils of a Galvanometer.

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OCTOBER 8. The Geary Water-tube Boiler. Damascus Gun-barrels.

OCTOBER 15. Transatlantic Mail Service. The Gledhill Built-up Gun. Our New Battle-ships.

OCTOBER 22. Recent Developments and Standards in Armor and Heavy Ordnance. Where Ships are Built and Owned.

NOVEMBER 5. Shipping Facilities at Brooklyn. The Naval Bureau of Ordnance. Casting Aluminum.

NOVEMBER 19. New Lake Vessels.

NOVEMBER 26. The United States Battle-ships and Class.

DECEMBER 3. The Origin of the Bessemer Process. Another Vessel Contract at Chicago. The Japanese Steel Works Commission. Rapid-fire Guns.

DECEMBER 10. A High-speed Corliss Engine. Aluminum Manufacture in Europe.

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NOVEMBER, 1896. Boiler Efficiency, Capacity, and Smokelessness, with Low-grade Fuels.

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NOVEMBER, 1896. On Crank-shafts. Tests of Riveted Joints made at the Watertown Arsenal, Mass. Contract Trial of the

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NOVEMBER 6. Accident to a Canet Quick-fire Gun. Experiments with Explosives in France. The Dudley Power Pneumatic Gun.

NOVEMBER 13. Navies of the World. Pumping Engines and Plant for Yokohama Dock.

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[FOREIGN.]

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NOVEMBER, 1896. The New French First-class Battle-ship Jaureguiberry. An Apparatus for Providing a Steady Platform at Sea for Search-lights, etc. The Dearth of Officers in the Volunteer Force. A Visit to the Lines of Torres Vedras. Notes on the Defense of the Bay of Algeciras. The Swiss Army Manœuvres, 1896.

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OCTOBER 10. What War Means—I. Effect of the Small-bore Rifle and Surgery. A Volunteer Reserve for the Navy.

OCTOBER 17. Armor and Heavy Ordnance. What War Means—II. War-ship-building in the United States. New First-class Cruisers.

OCTOBER 24. What the Country Owes to Nelson. The Penetration of the Lee-Enfield Bullet.

OCTOBER 31. The French Naval Manœuvres—III. Ranging by Clinometer. The Position of the Marines.

NOVEMBER 7. The Forces Made Use of in War. The Church in the Navy and Army. The Navies of Great Britain and Foreign Countries.

NOVEMBER 14. Trafalgar and To-day—II. Australian Defense.

NOVEMBER 21. Trafalgar and To-day—III. Austrian Artillery. The Development of the Japanese Army and Navy.

NOVEMBER 28. Supply of Ammunition to the Firing Line. Comparative Sea Power.

DECEMBER 5. The Speed Power of the Torpedo-boat Destroyer. Supply of Ammunition to the Firing Line—II.

DECEMBER 12. The Medical Officer in Action. Civilization and War.

DECEMBER 19. The Dutch Navy. Automatic Fire-arms. The Command of the Sea. A New Lee-Medford Bullet.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

OCTOBER, 1896. Shrapnel Fire of Field Artillery. Ranging by Clinometer. Flight and Flying-machines.

NOVEMBER. Astronomical Problems. The Kashmir Imperial Service Artillery. Notes on Austrian Artillery. The Coast Defenses of Northern Tunis. Range Officer.

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MORSKOI SBORNIK.

SEPTEMBER, 1896. War Games in the U. S. Navy. The Italian Expedition to Abyssinia. Experiments with Models of Ships' Screws. The Signification of Side Keels in Battle-ships

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OCTOBER. The Cradle of the Russian Fleet. Naval War of the Future. The Italian Expedition to Abyssinia. The Function of the Engineer. Mechanism Afloat in Time of War. Recent Advances in Matters Pertaining to Armor. The Question of Ships' Speed. Trials of the Turning Power of Torpedo-boats.

NOVEMBER. Commerce Destroyers in War. The Function of the Engineer. Mechanism Afloat in Time of War. Recent Improvements in Marine Engines. Notes on Metallurgy. Russian Explorations in the Sea of Marmora in 1894. The Gyroscope-collimeter (instrument for determining horizon for nautical observations at sea).

In this last number appears the following in relation to liquid fuel:

Experiments with naphtha fuel are in general progress in the navies of all nations, and the great value of the system is becoming generally appreciated. At the present time, in Germany, very large reservoirs are being built at Wilhelmshaven for the storage of naphtha residue, and it is proposed to construct similar reservoirs at Kiel and Dantzic.

In Italy liquid fuel is already in use for torpedo-boats, and is being introduced on large vessels as an auxiliary to the usual coal firing, for obtaining full speed without resorting to forced draught, etc.

J. B. B.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

VOL. IX., 1896. Photographs of Lights and Landmarks in Singapore and Malacca Straits. Sailing Directions for Wauchaufoo. Typhoon Highways in the Far East.

VOL. X. Hydrography of Samoan Islands. Some Notes on Trinidad, West Indies. Graphic Representation of the Errors in Observations for Latitude and Longitude. The Bore of the Tsien-tang-Kiang.

DEUTSCHE HEERESZEITUNG.

NO. 77, SEPTEMBER 23, 1896. Controlling the Movements of Several Armies. New Russian War-ships.

NO. 78. The French Autumn Manœuvres. Studies in Past Tactics. Russia's Volunteer Fleet.

The volunteer fleet of Russia in the Black Sea, destined for communication with Vladivostock, is subsidized under the Navy Department, with a naval officer at its head, and the vessels carry the man-of-war flag. In case of war they will be armed quickly; the batteries, ammunition and stores are ready at Odessa, Nikolajew, Sebastopol and Vladivostock.

These vessels, fitted as transports, have received permission from the Porte to pass through the Bosphorus and Dardanelles. New vessels are being built in England and France. They are of the "Pamjaty Mercuria" type, of 10,000 tons displacement, 20 knots speed, with destined armament of six 6-inch and eight 4.8-inch R. F. guns, besides a number of smaller guns. Four new vessels are to be added this year. The fleet at present contains 9 vessels.

Nos. 79-80. German Siege and Fortification Guns. Studies in Past Tactics (conclusion). Report on the Foundering of the Iltis.

Nos. 82-83. Fighting Tactics of Cavalry. Cavalry Weapons.

No. 86. Mounted Artillery with Cavalry Divisions.

No. 89. The First English Campaign in Matabele Land.

No. 90. The First English Campaign in Matabele Land (conclusion). Mounted Infantry in England. Laws relating to Messenger Pigeons in France. The following laws were promulgated:

Art. 1. Every person desiring to erect a pigeon cote must first obtain permission from the prefect of department.

Art. 2. Every person keeping permanently, or receiving temporarily, any pigeons, must notify the mayor within two days, with the place whence received.

Art. 3. There will be an annual census of pigeons, on a day determined by the Minister of the Interior, conducted by the local officials.

Art. 4. Every infraction of Arts. 1 and 2 will be punished by a fine of 100 to 500 francs. In addition, imprisonment for a term of 3 months to 2 years will be inflicted upon any one sending messages which may affect the safety of the state.

Art. 5. The Government may, upon recommendation of the Ministers of the Interior or of War, stop the introduction of pigeons from other countries, and any domestic pigeon service. Infractions of this article are punishable in the manner indicated in second paragraph of Art. 4.

H. G. D.

MILITÄR WOCHENBLATT.

Nos. 84 and 85, SEPTEMBER, 1896. Modern Repeating Arms (illustrated).

The article is devoted to a full description of Borchardt's repeating pistol, the construction of which is such that the recoil on firing opens the breech block, ejects the empty shell, cocks the firing pin, inserts a new cartridge into the chamber, and finally closes the breech, so that the pistol is ready to be fired after each discharge.

The magazine is in the pistol grip, holding eight cartridges. The barrel has a longitudinal play, and the recoil drives the barrel and breech mechanism to the rear, and by ingenious devices the above operations are automatically performed. The calibre is 7.65 mm., with a barrel 190 mm. in length. Weight, 1275 grms. Initial velocity 25 m. from muzzle is 400 m. per second. The penetration at 10 m. distance is through 2 men; or through 20 pine planks each 20 mm. thick, placed behind each other at 13 mm. apart. At same distance the bullets have pene-

trated a freely suspended steel plate of 3 mm. thickness. The rapidity of fire is surprising, 24 shots have been fired in 10 seconds, including the time for inserting 2 filled magazines. Tests have resulted in showing that shots are delivered at the rate of 22⅓ per second, or 1340 per minute, with the automatic firing arrangement.

There is practically no recoil upon the hand, as the force of recoil is exhausted in doing work. The pistol is especially adapted to cavalry use.

No. 87. Small-arm Targets.

Nos. 89 to 94. A Review of the Latest Inventions and Discoveries in the Military Field. The English Fleet. Trial Trip of the Victorious. Personnel of the Russian Navy at Sea.

The personnel actually at sea this year numbers 32,477, of which 14 are admirals, 1358 officers of different corps, 476 midshipmen, 336 engineers, 135 doctors, 37 chaplains, etc., 29,850 bluejackets and men. Five naval constructors are at sea.

No. 95. Armies and Fleets of the Present Day.

Nos. 98 and 99. Germany's Naval Policy and Naval Strategy.

The author, drawing lessons from the writings of Captain Mahan, points out strongly the need of a powerful German fleet of battle-ships for defensive and offensive operations in the future against England, Germany's probable future antagonist. He points out the growing commerce of Germany, making her England's most formidable rival, and, judging by past history, predicts England's resentment. He urges preparedness for this future struggle. An invasion of England made possible, the articles of peace may be dictated in London.

No. 100. Cavalry Attack in Extended Order. First Aids on the Fighting Line. H. G. D.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

Vol. XXIV., No. 10. Events at Sea during the Franco-Prussian War. Electric Motor for a Submarine Torpedo-boat. The Imperial Torpedo-boat Viper. Water-tubular Boilers on Holland's Cruisers. Foreign Navies.

No. 11. Engines of English War-ships. Progress in Armor and Ordnance during 1895. Yarrow's Automatic Feed. Reed's Water-tube Boilers for the English Destroyers. Foreign Navies.

No. 12. Ventilation on Board Ship. Tactical Problems in Naval Warfare. Defenses of the Coast and Approaches to Spezzia.

Gives full description, with chart, of the forts and batteries about Spezzia harbor.

Foreign Navies.

MARINE RUNDSCHAU.

October, 1896. Marine International Law in Time of War. Notes on Graphic Solutions of Problems in Spherical Trigonom-

etry. Detonating Explosives and Smokeless Powders. Tests of a Dürr Water-tube Boiler. The Arcona Class. Foreign Naval Notes.

November. The History of the Fleet. Does our Navy need a War College? The Imperial Gun-boat Iltis. Peculiarities of Vessels of the Brandenburg Class. Organization and Development of the French Lighthouse System. The Navy of the United States. Endeavors towards the Mental, Moral and Social Elevation of English Sailors. Foreign Naval Notes.

December. The History of the Fleet (continued). Germany's Sea Power. Burial of the Crew of the Iltis. Data on Steam Launches for Imperial Ships. Trial Trips of the Hecla. The Burning Coal Cargo of Sailing Ship Emilie, and how it was Saved. Organization and Development of the French Lighthouse System (concluded). The Navy of the United States (contiued). Foreign Naval Notes. H. G. D.

LE MONITEUR DE LA FLOTTE.

No. 36, September 5, 1896. Petroleum as a Fuel.

The use of petroleum for steaming purposes has been adopted on board all torpedo-boats in the Italian Navy. In Germany and Russia this fuel is daily growing in favor in the form of a residuum called astatki or mazout, resembling ordinary molasses. Its low price and high degree of combustibleness make it preferable to refined petroleum. In petroleum-producing countries like the United States, the cost of the article would be relatively insignificant.

No. 37, September 12. The Eckmuhl Lighthouse and the Men-Hir Beacon.

The Eckmuhl Light, at Point Penmarch, Brittany, begun in 1894, is rapidly approaching completion, and will be placed in operation in September, 1897. The average range of its electric rays will measure 100 kilometres. It will possess all the most recent improvements in machinery, etc.

No. 43, October 24. Questions of the Navy Personnel in regard to "L'Ecole des Hautes Etudes Navales."

No. 44, October 31. Speed an Illusion.

No. 46, November 14. The Navy Bill: Report of M. de Kerjégu, Chairman of the Naval Committee.

No. 50, December 12. The Naval Program. J. L.

REVISTA TECNOLÓGICO INDUSTRIAL.

September, 1896. Altimetry. Dampness in Cotton Spinning.

BOLETIN DO CLUB NAVAL.

August, 1896. Fuses in the Navy. Odontalgy in the Navy. Tables of Firing. The Climate of Rio de Janeiro.

SEPTEMBER. The Argentine Fleet. A Short Study of the Fuses in Use in the Navy (continued). Movements of Foreign Navies in the Port of Rio. Odontalgy in the Navy (continued). Tables of Firing.

REVISTA MARITIMA BRAZILEIRA.

AUGUST, 1896. The Late Improvements in Naval Ordnance and Armor. The Speed Problem. Petroleum as a Means of Raising Steam.

OCTOBER. Submarine Navigation. Spherical Trigonometry. The Cruiser Barros. J. L.

REVUE DU CERCLE MILITAIRE.

No. 36, SEPTEMBER 5, 1896. The War Department, Military Cabinet and General Staff in Germany. The Field Sanitary Service.

No. 37, SEPTEMBER 12. The Service in the Field: Remarks on the Regulations of May 28, 1895.

No. 38, SEPTEMBER 19. The Service in the Field, etc.

No. 39, SEPTEMBER 26 and OCTOBER 3. Letters from Madagascar.

These letters, written by a captain of artillery journeying from Tamatave to Antananarivo, give a graphic description of the nature of the country traversed and its inhabitants. Incidentally the correspondent refers to the discontented Tahavalos, who are active, through their brigandage, in retarding reorganization and return to prosperity in the island, but does not otherwise attach great importance to the so-called insurrection mentioned in the papers.

No. 41, OCTOBER 10. The Transsiberian Railway. The Oviedo Factory and the First Spanish Mausers.

No. 42, OCTOBER 17. The Emperor of Russia and the French Army at the "Camp de Châlons." The French Army Rifle.

No. 43, OCTOBER 24. Artillery Disposition for an Attack against a Defensive Position. The Service Rifle (continued). The School of Naval Higher Studies.

No. 44, OCTOBER 31. Army Medical Statistics for the Year 1894.

No. 45, NOVEMBER 7. The Army and Navy of the Future in Japan.

No. 46, NOVEMBER 14. Military "Cyclism" and the 2d Army Corps Manœuvres.

No. 47, NOVEMBER 21. Military "Cyclism," etc.

No. 48, NOVEMBER 28. The Transsiberian Railway and its Influence in Case of a War in Eastern Asia.

Nos. 49 and 50, December 5 and 12. Young Recruits and their Débuts in the Regiment. The Alpine Military Shelters in Italy. J. L.

REVUE MARITIME.

September, 1896. A Triangle of Lights to Indicate at Great Distances the Course of a Vessel. Installation on board the Brennus of an Apparatus indicating the Direction in which the Engines are working.

"The importance of such a contrivance may be conceived from the fact that recently, owing to the ignorance of the captain of the direction in which the engines were working, the safety of a U. S. man-of-war was imperiled while entering Newport's harbor."

An Attempt at a Classification of the Water-tube Marine Boilers. A Practical Guide to the Conduct of Court-martials on board Men-of-war.

October. Determination of the Meridian by Means of the Hour of an Ordinary Watch. Aid to the Wounded in Naval Actions. A Practical Guide to the Conduct of Court-martials, etc. (continued). An Attempt at a Classification of the Water-tube Boilers (continued).

November. Questions of Naval Strategy. Electric Installation on board the Cruiser Bugeaud. A Practical Guide to the Conduct of Court-martials (continued). Aid to the Wounded in Naval Action. Naval Stores and Material in Navy Yards.

J. L.

BOLETÍN DEL CENTRO NAVAL.

June-July, 1896. Electricity in the Navy.

August. Our Future Military Port (Navy Yard). A Report on the Manœuvres and Drills with the Torpedo-boat Flotilla. The Status of Naval Engineers. Steel for Ordnance.

October. The Future Military Port.

The establishment of a military port, or navy yard, has been for some time contemplated by the Argentine Republic. The necessity of such a port is admitted by all interested, but the question of site has given rise to lively discussions among experts; Luiggi, the government engineer, being in favor of building the port at Puerto Belgrano, in Bahia Blanca, some 18 hours from Buenos Aires, and Señor Diego Brown, the author of the pamphlet on the subject, at some convenient point in the estuary of la Plata, as being far more advantageous from a strategical point of view. J. L.

LE YACHT.

No. 968, September 26, 1896. The U. S. Naval Establishment: its Bureaus, Navy Yards and Private Shipyards (continued). The English Twin-screw Steam Packet between Dieppe and New Haven.

No. 970, October 10. Letters of Mark and Privateering (by V. G.).

French naval writers are far from being of one mind in regard to the advisableness, or non-advisableness, of delivering letters of mark in the case of war with England.

No. 971, October 24. The French Naval War College.

L'Ecole des Hautes Etudes de la Marine is the new name for the naval war school, which was at first established afloat, and lately transferred to Paris, as presenting greater facilities for the pursuit of the higher maritime studies, in the way of public libraries, records, archives, and above all, on account of lectures by eminent men on all subjects pertaining to the Navy.

No. 973, October 31. England's Naval Reserve.

The periodical cry of alarm is again being sent forth as the meeting of Parliament approaches. Though the motive (the weakness of the Navy) deceives nobody, even in England, the artifice never fails, and the result is a heavier call on the exchequer.

No. 974, November 7. On the Use of Wreckage in the Study of Ocean Currents. The Ernest Bazin.

The launch of the Ernest Bazin has fixed anew the attention of the public and experts upon this most curious invention of the roller-boat, and brought forth the most varied comments, both as to its scientific value and practical application. At any rate, M. Bazin is very sanguine touching the final result, and, for that matter, speed calculations bear out fully the previsions of the inventor.

New Naval Constructions in 1897.

No. 975, November 14. Promotion in the Navy.

For years back the French Ministry of Marine has labored hard to find a remedy to that baneful situation, a stagnancy in the Navy, and in spite of numerous bills introduced in Congress, appears as far from a solution of the difficulty as ever.

No. 976, November 21. The Auxiliary Cruisers again (see Yacht of October 10).

No. 977, November 28. The Navy: Six Months in the Rue Royale, by M. Lockroy.

A remarkable paper from the pen of the ex-Minister of Marine.

No. 978, December 5. The Navy Estimates for 1897.

The Navy Bill just reported by M. de Kerjégu, the Chairman of the Naval Committee, points out, in courteous but forcible language, the necessity of reforms in the administration of the Navy, and adds that a powerful fleet, strongly organized, and always ready for immediate action, was never more necessary to France than at the present time.

J. L.

SOCIÉTÉ DES INGÉNIEURS CIVILS.

August, 1896. Electric Traction in Railways.

September. Mechanical Traction Railways and principally Railways with Gas Motors. Theory of Singeing in Compressed

Elastic Pieces. Transmission of Power by Means of Electricity in Coal Mines.

OCTOBER. Trade Manufacture of Carburet of Calcium and Acetylene. J. L.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1897.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1898. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

H. G. DRESEL,
Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *December 31, 1896.*

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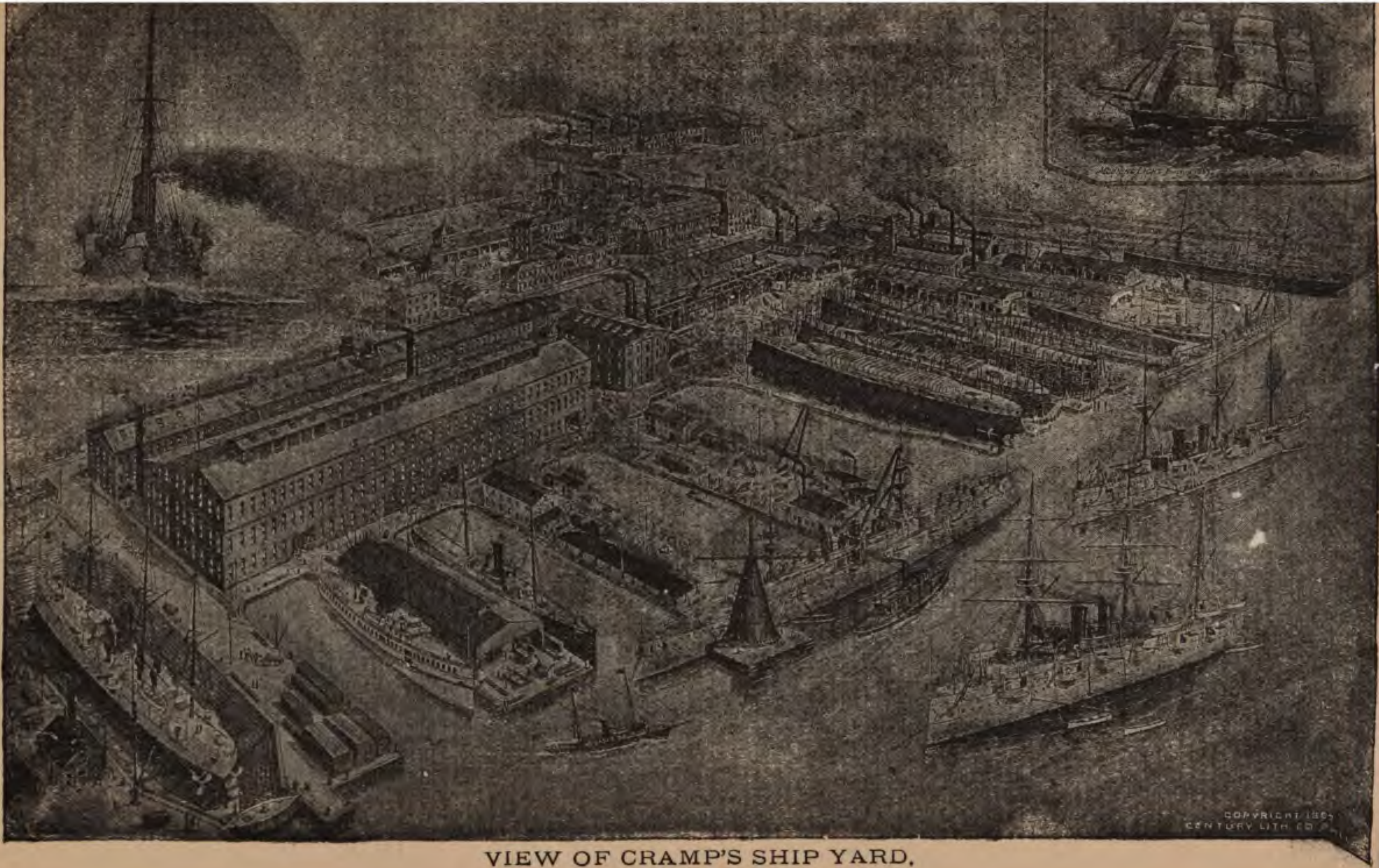

VIEW OF CRAMP'S SHIP YARD.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-fourth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.